1953

Efficiency of marketing eggs in Des Moines

Alan Stewart Goldman
Iowa State College

NOTE TO USERS

EFFICIENCY OF MARKETING EGGS IN DES MOINES

by

Alan Stewart Goldman

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major Subject: Agricultural Economics

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

Head of Major Department

Signature was redacted for privacy.

Dean of Graduate College

Iowa State College
1953

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INTRODUCTION

In this study consumer preferences for eggs are estimated in order to approximate the efficiency with which eggs are marketed in Des Moines.[1] Since it is possible to have more than one definition of marketing efficiency, it might be of aid to define what is meant by marketing efficiency at the outset.[2] The total efficiency with which eggs are marketed in Des Moines may be expressed symbolically as a vector:

$$u = (u^{(1)}, u^{(2)}, \ldots, u^{(\theta)}), \qquad (1)$$

where: u = total efficiency (utility)

$u^{(i)}$ = the utility of the i^{th} individual from the consumption of eggs

θ = the number of consumers in Des Moines

The vector, (1), is defined as greater than any other vector when at least one of its components is greater than the corresponding component of any other vector, and no

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[1] The concept of preferences as used in this context differs from the concept of demand in that only an ordering of desirability of physical characteristics is involved.

[2] This interpretation is taken from O. Lange. The foundation of welfare economics. Econometrica. 10 (nos. 3 and 4): 215-228. 1942.

other component is less. According to this definition, maximum marketing efficiency exists when no other change in conditions increases the vector, (1) -- i.e., it must be impossible to increase the utility of any person without decreasing that of others. It is obvious that the vector existing when consumer preferences are not reflected to sellers could be increased since sellers would produce qualities desired by consumers by chance.

If the utility of the i^{th} individual is defined as a function of the commodities in his possession, his utility may be expressed as follows:

$$u^{(i)} = u \quad (x_1^{(i)}, x_2^{(i)}, \ldots, x_n^{(i)}), \qquad (2)$$

where: $x_1^{(i)}, x_2^{(i)}, \ldots, x_n^{(i)}$ are the quantities of n commodities in the possession of the i^{th} individual. One of the n commodities is eggs.

The function (2), is subject to the constraint of the technological transformation function, $F(X_1, X_2, \ldots, X_n) = 0$ -- i.e., $X_r = \sum_{i=1}^{\theta} x_r^{(i)}$ is the total amount of the r^{th} commodity in the community, and is not a constant amount.

The problem with which this study is concerned is the maximization of the following utility function:

$$u^{(i)}(x_1^{(i)}, x_2^{(i)}, \ldots, x_n^{(i)})$$

$$= \text{maximum},^{1} \ (i = 1, 2, \ldots, \theta) \qquad (3)$$

in which one of the n commodities is eggs.

An efficient egg market will therefore be defined in this study as one in which consumers obtain the greatest amount of satisfaction possible in the consumption of eggs, so that no other method of marketing a given quantity of eggs will provide greater satisfaction. With reference to function (3), the market cannot be considered efficient if preferences for eggs are not reflected to sellers, since sellers would not have any particular reason for producing desired qualities.

The Problem in the Marketing of Eggs

When a consumer buys a particular quality of eggs, a dollar vote is registered on the retail level denoting that quality as preferred.[2] The retailer, in turn, compiles a large number of similar dollar votes and informs a jobber of the preferred grades by buying more of the particular grades for which more votes have been cast. This process

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[1] Function (3) is to be maximized under the present income distribution. Since eggs are used as the observational unit, nothing can be said about the other n-1 commodities which must be assumed as constant.

[2] This assumes that the consumer has alternative selections.

is continued back to the wholesaler, the car-lot shipper, and the local handler, finally reaching the primary producer.

The price paid to the producer is the actual determinant of the grades produced.[1] Price differences must provide sufficient incentive to induce the producer to supply the qualities preferred by consumers. Some producers will be influenced by price differences for grades and will consider it profitable to produce a better quality product; other producers will feel less incentive because they do not wish to give the extra care required to produce a higher quality product. The question on the production level is therefore a matter of resource allocation.[2]

The need for a consumer preference study arises when it is suspected that the pricing mechanism does not effectively reflect consumer preferences. The pricing mechanism can be particularly ineffective in reflecting consumer preferences for a commodity such as eggs. One reason for this is that eggs, generally speaking, appear to be of less importance in the minds of sellers and buyers than some other foods.[3] In comparison with a commodity

[1] "Producer" includes primary and secondary producers. A secondary producer is defined as any seller of eggs other than a farmer.

[2] The question of the ability of sellers to respond to preferences must be omitted because of the nature of the data analyzed. It is assumed that sellers can respond to preferences, and that the only reason they do not is because of imperfect knowledge of consumer preferences.

[3] This point is clearly established on pages 54-55 of this thesis.

such as meat, eggs may be given only comparatively minor consideration.

The hypothesis to be tested in this study is that the egg market in Des Moines is inefficient as a result of the inaccuracy with which the pricing mechanism reflects to producers the preferences of consumers for various egg qualities. If the hypothesis is confirmed, the problem then becomes the determination of methods for increasing this efficiency in order to increase the satisfaction consumers derive from the consumption of a given quantity of eggs. That is, the problem is to maximize the value of the function as in (3). This latter problem will also be dealt with in this study.

Background of the Grading System in Iowa

Consumer preference studies can be of further aid in establishing grade standards since grades used by private firms or governments can succeed only to the extent that they reflect consumer grade preferences. Preferences established in this study can be related to grades used in Iowa

Iowa law concerned with the sale of eggs requires that all eggs be candled to prevent the sale of inedible eggs for human consumption. Any eggs sold on U. S. Department of Agriculture grades, while voluntarily sold on that

basis, must meet the minimum requirements of the U. S. Department of Agriculture.

In Iowa, private agencies on all functional levels have established their own grades. Grading systems differ among egg handlers, and waste results from regrading in the marketing process as well as from imperfections in the reflection of consumer preferences. In so far as interior quality is concerned, most individual grading systems are similar to the U. S. Department of Agricultural recommendations, agreeing with the ordering of quality but differing in the numbers of quality differences.[1]

Problems in Methods

In addition to economic problems, the investigator in empirical research is confronted by a major personal problem in developing and using methods and techniques for obtaining and analyzing data relative to hypotheses. The answers to economic problems are of little value unless the techniques used in obtaining and analyzing the data are logically consistent. For this reason, the reader will find that

[1] In a study in Iowa, it was observed that the majority of handlers in Iowa, buying on grade, bought on a three-grade basis rather than on the U. S. Department of Agriculture four-grade basis. About 35 percent of the handlers bought eggs on less than a three-grade basis. Since this study included buyers shipping out of the state as well as within the state, the number selling on a three-grade basis within Iowa was overestimated. Cf. Baker, R. L., Factors affecting eggs marketed by certain producers. Unpublished Ph.D. thesis. Iowa State College Library. 1949. p. 25.

some of the answers on economic problems in this study actually play a secondary role compared to the attempt to find answers on questions of methods relative to the economic problems. It is hoped that the methodological observations will provide a provocative starting point for the reader who wants to improve his own research techniques in related marketing areas.

Methods of Collecting the Data

Four sample surveys are involved: The major sample, around which this report is developed, consists of data obtained from 503 households located in Des Moines. Interviews for this sample were taken in the period August 20, 1949 to September 20, 1949. Immediately following the household interviews, a store sample, drawn from stores mentioned by respondents in the major sample, was taken for the purpose of relating price-quality relationships on the retail store level to preferences on the household level. Six months later, in the middle of March, 1950, a subsample of the 503 respondents was taken primarily to check on methods used in obtaining data on the major sample of 503 respondents. Reference will also be made to a survey of 800 households conducted by R. L. Morse in Des Moines in the period of September to October, 1940.

The Effect of Time on Survey Data

The question may be raised how a survey can be of practical value in observing market efficiency beyond the time period in which the data are collected. It is assumed that the degree of efficiency observed in one time period is indicative of the degree of efficiency in the future. The voluntary reaction by sellers to the nebulous pressure of the many and varied consumer preferences is assumed to have considerable time lag.

Similarly, while consumer preferences as of the time of study may not be the same as preferences in the distant future, habit is such a strong influence that it may be assumed that consumer preferences, as of the time the survey is made, will be, for all practical purposes, the preferences of a later period. A study based on survey data can therefore be accepted as a method for observing the efficiency with which the Des Moines market operates for the period under study as well as for a period stretching into the future.

Outline of Analysis

In the ensuing pages, the analysis will proceed in the following manner:

(1) The major sample and other sources of data. Herein will be found a description of the major sample surveys and other related surveys.[1]

(2) Consumer preferences. Estimates will be made of consumer preferences for different interior qualities of eggs, yolk colors, shell colors, and shell cleanliness.

(3) Estimating the monetary value consumers place on preferences. The validity of using survey data for estimating how much consumers will pay for their preferences will be discussed.

(4) Preferences related to source of supply. Preferences will be related to estimates of quality factors provided by different types of sellers.

(5) Recommendations for improving the efficiency of marketing eggs. Recommendations will be based primarily on an interpretation of observations made by respondents on what they have found wrong in their purchases.

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[1] A Master's thesis by the author discusses the sampling problem more extensively. The treatment is less statistical, and covers the non sampling error question more fully than the present study. An appraisal of methods used in conducting a consumer survey. Iowa State College Library. 1950. pp. 78-113.

THE SAMPLE AND STATISTICAL PROCEDURE

Before going into the analysis of the economic problem, the survey techniques used in obtaining the data will be briefly summarized and analyzed. A large portion of this study is based on one sample survey, called "the major sample," and much of this section will be devoted to that survey. Three other surveys are also involved and will be discussed similarly but less intensively.

The Major Sample

The sample survey was considered the most appropriate tool for obtaining consumer preferences and attitudes toward the market. Enumeration had to be made at the home rather than in a store or along the street because of the difficulties in obtaining respondent cooperation for the designed schedule. In addition, the principle of randomness required observations to be made on each individual or group of individuals having an equal and independent chance of being interviewed. This principle would have been upheld on the store level only under relatively uncertain conditions. Street interviews can be random only with great difficulty.

Admittedly, instead of one large sample, a few or several smaller samples could have been taken at different time periods within the same season. For example, five different surveys taken at weekly intervals with 100 of the same or different respondents in each survey could have been a possible technique. The method might be considered as a means to a more dynamic analysis than can be presented in this study.

A probability sample rather than a judgment (quota) sample was decided upon. Jessen makes note from "general observation and other experiences" that the "judgment selection has its strongest case where (i) samples must be small, (ii) the universe is fairly small and visible or known to the selector, (iii) the elements in the universe vary considerably in the character under investigation, and (iv) the selector has great and proven skill in this art."[1] In the sample of Des Moines the antithesis of these requirements existed: (i) a large sample of households was decided upon, (ii) the universe consisted of about 48,000 households which were visible but unknown to the enumerators, (iii) little was known about the variation of any character under investigation, (iv) the selectors had no particular experiences or skills. Other than the practical

[1]Jessen, R. J. Unpublished mimeographed notes on sampling. Chapter III, p. 6.

weaknesses of the judgment sample, Jessen continues:

> One of the strongest points for the randomizing method . . . is that by randomizing the selection it is possible to obtain a measure of a sample's accuracy from the sample itself (for example its standard error of the estimate) . . . this measure of accuracy is not available in samples of judgment selection. . . .[1]

This latter point will be brought out in the following pages for the purpose of establishing an idea of reliability for the estimates used in the succeeding analysis.

Size and type of sample

A sample size of roughly 1 out of 100 was determined arbitrarily on the basis of time and funds available. Because a current listing of dwelling units[2] was not available, an area stratified sample was decided upon wherein the universe was divided into clusters of households. The stratified sample assured representation of all areas of the universe. Had a straight random sample been selected from the common lists available, such as the telephone directory or city directory, the sample would have been biased since one could not depend upon these listings being a complete census of the population.

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[1] Ibid. Chapter III, p. 6.

[2] A household consists of a family of any size living as an entity--i.e., eating together at the same table. The dwelling unit is the structure in which the family is housed. Reference will be found to indicated numbers of household or dwelling units--this refers to household or dwelling units as indicated by secondary sources, the U. S. Census on Housing or Polk's City Directory.

Method of drawing the sample

Briefly, the sample technique involved dividing the universe -- i.e., the corporate limits of the city of Des Moines -- into small contiguous areas (hereafter called clusters),[1] and randomly selecting a small proportion of these areas for the sample. In this way the chance of including every household in the universe was known, and unbiased estimates could be obtained. The universe was divided into 64 geographic strata. Two clusters of indicated size four were drawn at random from each stratum. Thus, the expected sample size was 64 x 2 x 4 = 512.

The number of strata, 64, was arbitrarily decided upon since an ample number was thereby provided above the desired total sample size of 500 dwelling units. Actually, 503 households were interviewed since one cluster was selected in one stratum, and some blocks had less than four occupied dwelling units.

The Sixteenth Census on Housing[2] was used as a basis for dividing the universe into 64 equal strata consisting of approximately 756 indicated dwelling units in each stratum. The stratum size was obtained by dividing the popula-

[1] A cluster is a street segment, a group of households in the city block.

[2] U. S. 16th Census: 1940. Housing--supplement to the first series housing bulletin for Iowa - Des Moines - block statistics. 1942.

tion of 48,287 dwelling units into 12,072 clusters of size four. The 12,072 clusters of size four, when divided by 64, provided 189 clusters in each stratum.

Block selection

Blocks within strata were selected at random with a probability proportionate to the number of clusters assigned to each block after the universe was divided into 64 strata. Data are presented in Table 1 to demonstrate how blocks were selected.

Table 1. Example of Block Selection

Block number	Indicated No. of dwelling units	Assigned No. of clusters of size 4	Cumulative clusters
1	10	3	3
2	5	1	4
3	20	5	9
4	60	15	24

With reference to the column, "Cumulative clusters," if a number, drawn at random, is between 1 and 3, the first block is selected; if 4 is drawn, then the second block is chosen; if a number between 4 and 9 is drawn, block 3 is selected. The probability of selecting block 1 is 3/24; block 2 has 1/24 of a chance for selection.

Cluster selection

Since block 3 has 5/24 of a chance of being selected and each cluster has 1/5 of a chance of selection, each cluster has an equal chance of being selected -- i.e., 5/24 x 1/5 = 1/24 of a chance for each cluster.

Up to this point, statisticians would agree that the sampling procedure is not unusual. Ordinarily, the next step would be to pre-list selected blocks by automobile or on foot (128 blocks in this case), list each dwelling unit, and check on how many families live in each apartment house, garage or basement. Obviously, the time and expense involved in such block enumeration would be great.

To lessen the difficulty and expense of block enumeration, a scheme was employed that substituted information provided in the Des Moines City Directory[1] for actual enumeration or pre-listing of selected blocks. The City Directory provides listings of households by streets, streets being listed alphabetically. It was a simple clerical job to list the house numbers in the block after

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[1] R. L. Polk and Co., 1949, Des Moines City Directory. Omaha, 1949. In correspondence with the Polk Publishers it was learned that the "bulk of the information for the . . . directory was secured during . . . September, October, and November (1948). . . ."

streets were located which surrounded the selected block.[1]

To divide the block into clusters, use was once again made of the 1940 Census on Housing. The indicated number of clusters of size four was computed for each block by dividing the total number of houses in the block as of 1940 by four. The indicated number of clusters of size four was then divided into the total number of houses as of 1949 to provide the cluster size for 1949. This may be understood more easily by means of an example:

Block I

Indicated number of houses (1940).....	24
Indicated number of clusters of size four (1940).....	6
Indicated number of houses according to City Directory (1949).....	26
Size of cluster (26 ÷ 6) (1949).....	4.5

In this case the Census listed 24 houses in the block or 6 clusters of size four. The Directory indicated that in 1949 there were 26 houses. The cluster size therefore was 4.5 as of 1949.

The rule was established for blocks having non-integral cluster sizes (in this case, 4.5 households per cluster) that the first clusters would have whole number values,

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[1]The numbering of houses in Des Moines is orderly, greatly simplifying this scheme. The city is divided into 3 sections by the Des Moines and Raccoon Rivers. The eastern section has odd house numbers on the east and south, even numbers on the west and north; the western section has odd numbers on the east and north, even numbers on the west and south; the southern section has odd numbers on the east and north, even numbers on the west and south.

the latter clusters having the remainder. To make this clearer: The first four clusters in the example noted above (clusters were numbered counter-clockwise starting at the southwest corner of the block) were assigned 4 households. The last 2 clusters, clusters numbered 5 and 6, were composed of 5 households. Cluster selection was then accomplished by random draws.

Bias does enter into this sample. Only the first 4 households were interviewed in each cluster. Since there were clusters larger than size four, every household did not have an equal chance of entering into the sample. However, this bias is lessened since a majority of clusters as of 1949 were of size four. In addition, liberal rules for substitution, which are presented on page 17, were established such that latter households in the cluster had a higher probability of being interviewed than if stricter substitution rules had been established.

Other Sources of Data

Mention will also be made of data obtained in three other sample surveys. Two of the surveys are related to the major sample survey. The third is a consumer survey similar to the major sample taken by R. L. Morse in the City of Des Moines in 1940.

A sample of the major survey taken in 1949 will first be discussed. One survey is involved with retail stores mentioned by 340 respondents in the major survey; the other survey is a sub-sample of the 503 respondents of the major survey.

The store survey

The store survey was taken immediately after the consumer survey was finished. The purpose was to observe what respondents actually received in the way of eggs -- i.e., with regard to interior quality, size, cleanliness of shell, shell color, price -- in contrast to what they said they wanted and received.[1]

A complete list was made of stores mentioned by respondents in the major survey as a general source where eggs were purchased. A store was listed every time it was mentioned by respondents.[2] Difficulties occurred in the major survey that may have weakened the value of the list of stores. Occasionally enumerators in the survey of 503

[1] In each selected store, enumerators asked the clerk for a dozen of the best eggs. The eggs were then brought back to Iowa State College and candled.

[2] When listing general sources of purchase, 174 different stores were obtained with 104 duplications or a total of 278 store purchases. Since 161 respondents bought eggs from producers and 17 families either did not eat eggs or raised their own, the total number of schedules was 456. The remainder was discarded for lack of sufficient information.

households failed to obtain complete information and some stores listed could not be found or had incorrect addresses.

A random sample of 50 stores was drawn so that each listed store had an equal and independent chance of entering the sample.[1] The sample was drawn without replacement and naturally had a bias toward over-representation of smaller stores. To compensate for this, responses for larger supermarkets were weighted proportionate to their representation in the population from which the sample was drawn.

Subsample of 503 households

A subsample of consumers was taken six months after the major sample was completed. The purpose of this sample was to note any change in quality obtained by consumers in the spring and to check on the quality of responses for a technique used in the original survey of 503 households.

In order to obtain a geographical spread in the subsample, one household was selected at random in each of the 64 strata. Within each stratum, households were renumbered from 1 to 8. The households of the cluster in the lowest block were numbered 5 to 8. The lowest number in each case was assigned to the "southwest corner" household, higher

[1]Three stores of the original 50 could not be located. This store sample is referred to in the presentation as "the sample of 47 retail stores."

numbers being assigned in a counter-clockwise direction. To provide substitutes for missing households, a second group of households was selected in identical fashion to the original subsample.

Survey by R. L. Morse in 1940

The survey by Morse in Des Moines in 1940 was taken for the same purpose as the major sample discussed above. The universe in this case consisted of Des Moines and the adjacent areas of Fort Des Moines and West Des Moines. A sample size of 800 was taken, 1.5 percent of the households of 1.7 percent of the population in Des Moines. Omitting the business district, the sample was selected by counting every 70th household in the Des Moines City Directory.

> Later, the sample was distributed among the 44 census tracts and the percent of dwelling units (1940 census) samples was calculated. These percentages range from 0.25 to 2.40 percent with a mean value of 1.52 percent. One census tract in the business district was not included in the sample and another tract which was primarily a business district was only partly included in the sample. Only 0.25 percent of the dwelling units in this tract were included in the sample. In the 43 census tracts sampled, between 1 and 2 percent of the dwelling units were included in the sample. In 5 tracts over 2 percent of the dwelling units were sampled and in 3, less than 1 percent. Hence, by this sampling procedure, wide and fairly uniform geographical coverage of the city was secured.[1]

[1] Morse, R. L. Egg grading and consumer preferences. Unpublished doctoral dissertation. Iowa State College Library. 1942. pp. 136-137.

Substitution Rules[1]

Rules for substitution for those not found at home by enumerators are presented because of the influence they may have had on the results.

In the major sample, the city was divided into two groups, "homogeneous" and "heterogeneous." A homogeneous area consisted of the following:

(1) A block in which there was only one family per building.

(2) An apartment house.

(3) The extremely poor and the extremely wealthy blocks.

It was observed that living habits, income, and external appearances tended to be the same within these groups. Those blocks or dwelling units not falling in the above categories were called "heterogeneous."

The division into heterogeneous and homogeneous groups simplified substitution rules. Within homogeneous groups, substitution was much more liberal than within heterogeneous groups. Substitutions were made within homogeneous groups for the following reasons:

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[1]Such non sampling factors as the enumerator and coding will not be discussed. Observations on these factors may be found in the author's Master's thesis. op. cit. pp. 94-107. Substitution rules are presented in view of an element of arbitrariness in their formulation.

(1) A refusal.

(2) The respondent was busy.

(3) Three or more recalls made at one household.

(4) Family on vacation.

(5) Illness.

(6) Senility or a general inability to comprehend and respond thoughtfully.

(7) Housewife shopping or no one at home capable of answering the questions.

Substitutions were made within heterogeneous groups only for reasons (1), (3), (5) and (6).

Within both groups, heterogeneous and homogeneous, an attempt was made at limiting the number of substitutions to two per cluster. Of the 128 clusters selected, only five had more than two substitutions per cluster. There was a total of 110 substitutions.

When substituting, enumerators always selected the next house going in a counter-clockwise direction until the number interviewed equalled the number selected in the original cluster.

In the store sample, no substitutions were made for the 50 stores initially selected. Since three stores were not found, only 47 stores were secured.

In the consumer subsample of 64 households initially selected, only one call back was made before a substitution was made. Substitutions were made for refusals, death, or

if the original respondent had moved. Calls were made on working couples in the evening.

In the 1940 study, Morse substituted freely for housewives out shopping or visiting by interviewing the next door neighbor. Call backs were made at opportune times in all other cases.

Statistical Analysis of the Major Sample

In the major sample, means and percentages are in many cases the only estimates that can be used. Tests of significance for these estimates are not directly possible since individual observations in the sample were not random and the assumption of independence required for tests of significance (independence of observations) cannot be met.

The sample was random only in the selection of clusters. For this reason, the following methods could have been employed which would have permitted the use of common tests of significance:

(1) A random sample could have been taken of the 503 schedules. The best use of all information would not have been made if this was done.

(2) The population could be assumed as homogeneous. This assumption would have been highly questionable.

(3) A ratio estimator could be used along with a two standard error confidence limit based on the variance of the ratio estimator.

(4) Cluster totals could be used to establish confidence intervals and to estimate sampling error.

The fourth method was decided upon since it was simple and provided the desired information. Four "crucial" variables were selected on which to establish confidence limits and sampling error. The variables were selected on the basis of estimated extremes in variability and their importance in the analysis. The variables were the number of eggs used by the household for a week, the price paid per dozen, the number in the household and the total income.[1] The analyses of variances for the above variables are presented in Table 2.

Total income is analyzed because of its importance in the presentation that follows. The weakness in its use stems from the assumption made before enumeration that respondents would be hesitant about accurately stating their incomes, particularly in the upper middle income brackets. Moreover there was little reason to believe that with a commodity such as eggs, income would help to "explain" the variation in consumption in the "above-100-dollar" income bracket. For these reasons, actual incomes were obtained only for families with incomes below 100 dollars per week.

Egg prices are also analyzed because of their importance. The analysis of this variable is not as useful as was hoped

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[1]Cluster totals were weighted by the number of households in the cluster. If a cluster had 5 households, but only 4 were interviewed, the cluster total was weighted by 5/4.

Table 2. Analysis of Variance for Four Variables

SV	d.f.	SS	MS	EMS
Number Eggs Used				
Among strata	63	129,680	2058	$\sigma^2 + 2\sigma_s^2$
Between clusters	64	148,886	2326	σ^2
Total	127	278,566		
Price Paid per Dozen				
Among strata	63	542,343	8609	$\sigma^2 + 2\sigma_s^2$
Between clusters	64	545,907	8530	σ^2
Total	127	1,088,250		
Number in Household				
Among strata	63	2742	43.5	$\sigma^2 + 2\sigma_s^2$
Between clusters	64	2556	39.9	σ^2
Total	127	5298		
Total Income[1]				
Among strata	63	5,004,967	7944	$\sigma^2 + 2\sigma_s^2$
Between clusters	64	3,785,757	5915	σ^2
Total	127	8,790,724		

[1] Total income was obtained by asking respondents the earnings of each member of the household and summing the earnings for the family. A card with income brackets was used for respondents not wanting to give this information directly.

since many respondents purchased eggs outside the strata for which they are accredited.

One further point should be noted: In the F tests computed for all variables in Table 2, no significant differences between clusters and strata means is found. This might be interpreted as showing that the city of Des Moines is more homogeneous than suspected such that stratification was unnecessary. This conclusion is in conflict, however, with actual observations. It is suggested that the homogeneity stems from the limitations mentioned above in gathering the data for income and prices for eggs, and (possibly most important) the method used for stratification in which strata consisted of households rather than the particular variables examined.

From the cluster variances, the standard error of the means for the variables may be computed to estimate the percent sampling error. The findings are shown in Table 3. The percent sampling error for the crucial variables provides a method for comparing means directly in the analysis that follows.

Confidence limits computed from the survey of 503 households provided the following interval estimate of the population in Des Moines:

$$T = \frac{C(\bar{x} \pm t_{(.05:126)}\, s_{\bar{x}})}{P},$$

$$T = \frac{127[12.7 - (1.984)(.57)]}{.0105},$$

$$T = 153{,}610 \pm 13{,}667.$$

Where:

T = estimated total population

$\bar{x}$ = mean size of cluster

$s_{\bar{x}}$ = standard error of mean size of cluster

C = total number of clusters in the sample

P = C + total number of clusters in the universe

Table 3. Sampling Error Estimates[1]

Variable	Mean of cluster totals	Standard error of mean	Percent sampling error
Number eggs used	80.7	4.30	5.3
Price paid	208.4	8.30	4.0
Number in household	12.7	.57	4.5
Total income	338.8	6.90	2.0

[1]Computations are based on clusters rather than individual observations.

The limits do not include the parameter of the population (177,965 people in Des Moines).[1] A 13 percent underestimation is indicated. Some of the underestimation may be explained by the following:

(1) There is a tendency for respondents to forget to include children under two years of age as members of the family.[2]

[1]U. S. Bureau of the Census. Census of Population: 1950. General characteristics -- Iowa. U. S. Government Printing Office. 1952. p. 35.

[2]Ibid. p. VII.

(2) While the census included aunts, uncles, and other similar residents in the home as members of the family, the sample of 503 households does not.

(3) About 5 percent of the Des Moines population lives in hotels and rooming houses which were not included in the sample.[1]

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[1]Other estimate comparisons with the 1950 census population are as follows: The percent Negroes in the major sample is 5.2; the Des Moines census is 4.6. The mean size of household in the major sample is 3.15; in the census it is 3.05.

CONSUMER PREFERENCES FOR QUALITY FACTORS

Previous Consumer Preference Studies

Consumer preference surveys on eggs date from 1928 when Lininger and Charles conducted interviews with 2,404 families in six cities in Pennsylvania.[1] The study was directed at examining factors affecting consumer demand and the source and quality of the supply of eggs and poultry in Pennsylvania.

In 1928, Thomsen and Winton conducted a survey on consumer preferences for yolk and shell color in New York City in order to investigate what was considered discrimination against midwestern eggs.[2] To obtain observations on yolk color preferences, actual eggs of light, medium and dark colored yolks were displayed in white porcelain dishes in selected chain stores. The position of the dishes was changed every day. Customers were asked which of the three eggs in the dishes was preferred. After a choice had been made, the respondent was asked if color was the reason for

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[1]Lininger, F. F. and Charles, T. B. A study of egg and poultry consumption in Pennsylvania -- the nature of consumer demand and the source and quality of supply. Pennsylvania Agricultural Experiment Station. Bulletin 222. 1928.

[2]Thomsen, F. L. and Winton, B. Consumer preferences for egg yolk color and shell color in New York City. Missouri Agricultural Experiment Station Bulletin 329. 1933.

his choice. Shell color preferences were obtained by displaying one dozen of brown and white shell eggs of the same size and uniformity, and asking customers to express their preferences for the colors displayed.

Corbett in 1933 published a study consisting of two surveys of the same areas which were conducted in 1928 and 1932.[1] The purpose of the surveys was to learn about consumer habits in buying eggs and consumer preferences for egg quality. The comparison of the two economic periods was intended to provide information on changes in consumption caused by varying economic conditions and changes in tastes and preferences.

Liston in 1927 reported on a consumer preference study on seven commodities.[2] Respondents were asked to describe the characteristics which they considered essential in each commodity. Questions were then asked about different quality factors and respondents provided "Yes," "No," or "uncertain" answers. Questions were related to specific uses. Although it was admitted that respondents may have described desired qualities rather than those obtained, the author believed that the bias was minimized by relating questions

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[1] Corbett, R. B. A study of consumer preferences and practices in buying and using eggs. Rhode Island Agricultural Experiment Station. Bulletin 240. 1933.

[2] Liston, M. L. A study of quality demands in household buying of food. Vermont Agricultural Experiment Station. Bulletin 415. 1937.

and answers to actual purchases which were commonly made during the week.

In Iowa, consumer preferences for shell and yolk colors have been investigated by Morse, Reid and Oderkirk. At a meeting of women at Iowa Farm and Home Week, respondents were shown different yolk colors in petri dishes and asked if all colors were acceptable for frying and poaching.[1] Respondents were asked to designate by numbers, for the respective eggs that were displayed, the order of their preferences as well as those colors that were disliked.

Following this study, the same investigators secured information on consumer preferences and consumption habits at the farm level in 15 counties in Iowa.[2] Home demonstration and extension nutrition specialists were trained on filling out schedules, and then returned to their townships where women in the township meetings filled out the schedules. Completed schedules were returned by mail.

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[1]Morse, R. L., Reid, M. G. and Oderkirk, A. D. Yolk color preference of some women attending Farm and Home Week, 1939. Iowa Agricultural Experiment Station. Project 628. Unpublished study.

The Iowa studies that are discussed in this chapter have never been published. The reviews are based upon brief reports presented by Morse.

[2]Morse, R. L., Reid, M. G. and Oderkirk, A. D. Egg preferences of 1878 rural women in Iowa, February-May, 1940 and January-February, 1951. Unpublished study.

The same investigators conducted a survey in Des Moines in 1940.[1] The study was undertaken to secure information concerning egg preferences of Des Moines consumers and some of the factors affecting these preferences. To obtain preferences on yolk color preferences, six yolk colors were displayed in a wooden box, 2.5 inches x 5 inches x 18.5 inches. Difficulty was encountered in preserving the yolks which were encased in gelatin under watch glasses. Morse observed that position of the yolk colors in the box appeared to influence responses. This survey was the basis for the present study. Many results for the two studies, 1940 and 1949, will be compared simultaneously.[2]

[1]Morse, R. L., Reid, M. G. and Oderkirk, A. D. Des Moines consumers' egg preferences, consumption and buying practices, 1940. Iowa Agricultural Experiment Station. Project 628. Unpublished study.

[2]Of more recent surveys, two novel techniques have been used: Larzalere and Nichols inserted questionnaires concerned with consumer preferences and egg buying habits in cartons of eggs at the time of packing at grading stations. Of 2,745 questionnaires, 182 were returned, making the results somewhat suspect. Cf. Larzalere, H. E. and Nichols, W. A. What consumers think about the eggs they buy. The Quarterly Bulletin. Michigan State College. 32 (no. 4):513-519. 1950. The same technique of using postcards in egg cartons was used in the State of Washington. Of 16,000 postcards, more than 25 percent were returned. Cf. Stadelman, W. J. Consumers tell what kind of eggs they want. U. S. Egg and Poultry Magazine. 56(no. 6):12-13. 1950. From personal conversation it has been learned that R. L. Kohls and N. Oppenheimer of the Purdue Agricultural Experiment Station entered households and inspected eggs of selected respondents. This is the well known "pantry technique," and is unique since interior quality of eggs was examined at the time.

Consumer Preferences for Quality Factors

Consumer preferences must first be established previous to estimating the ability of the pricing mechanism to reflect consumer preferences. Estimates of consumer preferences will now be presented for the following factors in eggs: interior quality, shell cleanliness, shell color, and yolk color.

Interior quality preferences

To obtain interior quality preferences, top view colored photographs of four U. S. Department of Agriculture Consumer Grades, "AA," "A," "B" and "C," representing eggs immediately after they were broken out of the shell, were pasted on a circular cardboard, randomly numbered, and shown to respondents.[1]

The results of the first survey for 503 respondents are presented in Table 4.

Note that grades AA and C are selected as the best by an almost equal percent. At the same time the most out-

[1]Respondents were told that numbers accompanying each picture meant nothing more than identification of the egg, that the eggs were all of the same size, and that color differences were only the result of photography. Then they were asked to rank the eggs from the best to the poorest. Photographs of the chart used may be found in Appendix A.

standing selection for second choice is grade A. Similarly, third choice is grade B and fourth is grade C.

The percentages for rankings are confusing although some significance is suspected. To check on this significance, the technique of "m" rankings (hereonin referred to as rank correlation analysis) was employed to test the agreement between respondents on grade preferences.[1] Rank

Table 4. Ranking of Eggs by 503 Respondents

Grade	Rank							
	First		Second		Third		Fourth	
	No.	%	No.	%	No.	%	No.	%
AA	189	39.1	108	22.8	74	15.7	101	21.3
A	87	18.0	228	48.2	118	25.0	41	8.6
B	20	4.1	118	24.9	251	53.2	86	18.1
C	187	38.7	19	4.0	29	6.1	247	52.0
No information	20	--	30	--	31	--	28	--
Total	503	99.9	503	99.9	503	100.0	503	100.0

correlation analysis indicated that respondents were in common agreement, on the 1 percent level of significance, in not being able to distinguish differences between AA and A, but were able to distinguish differences between

[1]The method for this analysis may be found in the text by M. G. Kendall. Rank correlation methods. Charles Sniffin and Co., Ltd. London, 1948, pp. 80-89.
The computations for the rank correlation analysis may be found in Appendix B.

AA (or A) and B, A and C, and B and C.[1] Significant preferences were indicated for AA (or A) over B, and B over C.

There is a conflict between the results of Table 4 and the rank correlation analysis. That is, an equal number selected AA and C as best and yet rank correlation analysis indicated AA was preferred significantly over C. However, if, having summed all the preferences of all the rankings in Table 4 (which is what the rank correlation method does), it is found that respondents did not prefer AA over A (or vice versa) than C must be ranked as second to AA (or A).

Note the small number referring to C as a second or third choice. Other than the large number preferring C as first, C is referred to in no other ranking by a large number of respondents except as the least preferred grade. To analyze Table 4 from the point of view of each individual ranking alone denies the simultaneous influence of the other rankings in the over-all picture. In an analysis of rankings, it would appear to be more logical to take into account more than one ranking at a time since respondents had to develop their selections on that same basis.

Inconsistencies in preferences for grades

While significant preferences were found, preferences

[1] The rank correlation coefficients may be found in Table 8.

and reasons given by respondents for these preferences were not always consistent. For example, respondents often selected a grade C egg as the best, but, in giving reasons for this selection, described a grade AA egg.

An example of inconsistent selection and reasons for selection is presented in Table 5.

Table 5. Reasons Why C Egg Selected as Best

Reason	Number	Percent
Just like it	16	8.6
Upstanding yolk, white, thick and firm, not spread out	28	15.0
Thin white, spreads out evenly, no second layer of white	32	17.1
Larger yolk	51	27.2
No chalazae or white stuff along side of yolk	6	3.2
Yolk centered	4	2.2
Larger yolk, no second of white	6	3.2
Miscellaneous	44	23.5
Don't know	6	
	187	100.0

The grade C egg depicted on the chart had a flat yolk, thin white, was not well-centered, nor was the yolk larger. Note that 15 percent described the yolk as upstanding. And, although enumerators informed respondents that all eggs were of the same weight -- i.e., of the same size -- 27.2 percent of those selecting the C egg as best, described the

yolk as larger.[1] Had the enumerators attempted to correct inconsistencies in selection with reasons for selection, enumerator bias might have entered into the response. For this reason, enumerators were instructed to report all responses without question.

Subsample interior quality preferences

Because of inconsistencies in descriptions of the photographs, it was determined to observe the reliability of the top view chart responses in a subsample of the original 503 respondents. To accomplish this, two charts were used: The original chart having only the top view of the four grades, and a second chart[2] having the top view and profile of the respective grades. The results of the subsample of 63 respondents for the two charts are shown in Table 6.

The rankings of the second survey are essentially similar to the first survey although agreement on ranking appears more marked. For example, 39.1 percent of the 503 respondents of the first survey placed AA first and 38.7 percent placed C first; the top view chart of the

[1]Other selections and reasons for selections may be found in similar tables in Appendix C.

[2]This chart is in Appendix A.

Table 6. Ranking of Eggs by Respondents in Subsample

Grade	First		Second		Third		Fourth		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Grade Ranked (Top View Chart)										
AA	25	45.5	10	18.2	7	12.7	13	23.6	55	100.0
A	12	21.8	31	56.4	10	18.2	2	3.6	55	100.0
B	1	1.8	12	21.8	34	61.8	8	14.5	55	99.9
C	17	30.9	2	3.6	4	7.3	32	58.2	55	100.0
Total[1]	55	100.0	55	100.0	55	100.0	55	100.0		
(Top View and Profile Chart)										
AA	26	45.6	16	28.1	9	15.8	6	10.5	57	100.0
A	20	35.1	29	50.9	6	10.5	2	3.5	57	100.0
B	1	1.8	10	17.5	39	68.4	7	12.3	57	100.0
C	10	17.5	2	3.5	3	5.3	42	73.7	57	100.0
Total[2]	57	100.0	57	100.0	57	100.0	57	100.0		

[1]Five selections involving ties between AA and A and three "no information" rankings are omitted.

[2]Involves three ties and three "no information."

second survey shows a keener discrimination between AA and C; the profile chart shows an even more marked distinction. This is true throughout the rankings.

The reasons for rankings, presented in Table 7, show similar results -- i.e., more consistent agreement and accurate description than on the major survey. In the rankings of the profile chart, only 6.4 percent described the C egg as upstanding, thick, white, etc., in contrast to 21 percent for the top view chart of the first survey and 9.8 percent for the top view chart used in the second survey.

Comparing results of the two surveys

A note of caution should be added to these results: On the first survey, before it was realized that the value of the top view chart was to be tested, enumerators informed inquiring respondents of the "correct" ranking of the eggs at the end of the interview. This feature in addition to added familiarity with the photographs in the second survey appears to explain a good portion of the differences in the two surveys.

Everything considered, it is believed that the only valid comparisons that can be made are between the two types of charts used on the second survey. In this case the differences in percentages in the ordering from best to worst

Table 7. Selection and Reasons for Preferences in the Subsample

Egg selected as best	Reasons	TOP VIEW CHART No.	TOP VIEW CHART %	% picked egg as best	PROFILE CHART No.	PROFILE CHART %	% picked egg as best
AA	Just like it.....	1	1.6		0.0	0.0	
	Larger yolk.....	1	1.6		0.0	0.0	
	Yolk upstanding, thick white, stands up, etc.[1].....	27	44.3	47.5	28	45.9	45.9
A	Yolk upstanding, thick white, stands up, etc.....	12	19.7	19.7	21	34.4	34.4
B	Yolk upstanding, thick white, stands up, etc.....	1	1.6		0.0	0.0	
	No information.....	0.0	0.0		1	1.6	
C	Larger yolk.....	5	8.2		3	4.8	
	Yolk upstanding, thick white.....	6	9.8		4	6.4	
	No chalazae.....	1	1.6		0.0	0.0	
	White thin, water and smooth.....	6	9.8		3	4.8	
	Other coherent answer	1	1.6		0.0	0.0	
	No information	0.0	0.0		1	1.6	
	TOTAL		61*	99.8	61*	99.5	

[1]Includes ties between AA and A. *No information on two respondents.

are not confounded by enumerator-respondent relations in the first survey.

Results established in the two surveys

Two questions now remain to be answered:

(1) Are the quality preferences of the first survey of 503 respondents the same as those of respondents in the subsample?

(2) Does the profile chart aid respondents in noting preferences?

To answer the first question, the coefficients of concordance, W's, were computed by the rank correlation method. A summary of the coefficients for the two surveys and the two types of charts is presented in Table 8.

Table 8. Summary of W's Obtained in the Two Surveys

Charts	Grades			
	AA vs. A vs. B vs. C	AA vs. A	A vs. B	B vs. C
First Survey				
Top view	.0852**	.00758	.0922**	.175**
Second Survey				
Top view	.120**	.000669	.146**	.146**
Profile	.326**	.00770	.224**	.468**

**Significant on the level of .01.[1]

A most encouraging feature of the rank correlation coefficients is the consistency throughout. On both surveys and on both charts, W's are significant on the one percent

[1] "W's" range from 0 to 1. That such low W's are significant in the first survey may be accounted for in the large number of observations.

level for all grade comparisons other than AA versus A. In addition, note that the W's increase in size, (except for the one case of B versus C for the top view charts) not only between the first survey and the second, but also between the two types of charts in the second survey. The increase in the value of the coefficients for the top view charts in the two surveys is probably a result of enumerators explaining the features of the grades when the first survey was taken. But this confounding does not occur when comparing the two charts of the second survey.

Response differences between top view and profile charts

To test for independence in responses in the two charts used in the subsample, the coefficients were transformed to z's and the difference between the z's tested for significance.[1] The difference between the z's was significant on the 24 percent level. This would indicate on the 5 percent level of significance that the responses to the second chart (with profiles) were not independent of the responses to the first chart. Nevertheless, the more accurate descriptions of the profile chart do indicate that the profiles were of aid in selection and description by respondents.

[1] Cf. Snedecor, G. Statistical methods. Fourth edition. Iowa State College Press. 1946. pp. 150-152. The "t" test of significance would have required the assumption of independence for observations between the two charts. As noted, this assumption is invalid. Cf. Appendix D for further discussion on the independence of observations between the two charts.

Conclusions on interior quality preferences

On the 1 percent level of significance it is concluded that consumer preferences exist in Des Moines, grade AA (or A) being the most preferred, B the next preferred, and C preferred least of all. There is no significant common agreement on AA being more preferred than A or vice versa.[1]

One point should be emphasized: the above conclusions in no way establish that producers should only attempt to market grade A eggs. As noted in the cross tabulation of results, some respondents do prefer grade C over A. For those respondents, grade C eggs are more acceptable for marketing than A's. The only conclusion one can draw from the analysis is that consumer preferences for interior qualities do exist, a majority preferring grade A over B and grade B over C.

Factors Other Than Interior Quality

Grades, as referred to above, consist only of the physical characteristics of the egg immediately after the egg has been broken out of the shell onto a flat surface -- i.e., as an egg would appear right after it has been dropped

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[1]Obviously, in order to make any inferences to the actual marketing of eggs, one must assume that preferences noted are for the interior quality of eggs as such, and not for the photographs used in obtaining observations.

on an unheated frying pan. But there are factors other than interior quality that must be taken into consideration in the grading of eggs. Cleanliness of the shell, color of shell, and possibly the color of the yolk, are factors that might be taken into account in any grade standard.[1]

Shell cleanliness

Of 477 respondents asked about the exterior condition of eggs last purchased, 10 percent complained of dirty eggs. This is in sharp contrast to the results of the survey of 47 stores. Of 564 eggs graded according to U. S. Department of Agriculture minimum recommendations, 29 percent were classified as dirty; of 47 dozen eggs, 47 percent had 10 percent or more dirties, and 34 percent had 20 percent or more dirties.[2] By consumer standards, as measured by those complaining of dirty shells, the U. S. Department of Agriculture recommendations for consumer grades would seem unduly high.

This should be qualified further: the question asked of consumers on exterior quality was of the open-end type.

[1]The assumption is made that the egg does not have a cracked shell, blood spot or the like. These defects are involved in grading but are not necessary for the discussion that follows. Unsatisfactory eggs having these defects will be discussed in the following pages.

[2]The U. S. Department of Agriculture standards for consumer grades require that no dirties be allowed in grades AA or A, a 10 percent maximum of dirties in grade B, and a 20 percent maximum of dirties in grade C.

Considering lack of cooperation as well as memory bias, the above results can do little more than open up new problem areas for further investigation. Empirical evidence is now required on what consumers consider acceptable cleanliness to be. In view of the success in obtaining preferences for interior quality by means of photographs, it might be possible to use the same technique for discerning what consumers mean by "dirty shells."

Shell color preferences

From data obtained by Morse in a survey in Des Moines in 1940, it was observed that 53 percent of those interviewed had no preference for any shell color, 32 percent preferred brown shells, and 15 percent preferred white. Respondents in the major sample in 1949 were asked whether they preferred any shell color. A comparison of the results for the two periods, 1940 and 1950, are presented in Table 9.

In comparing the number of respondents with preferences for shell colors in the 1940 study with the number with preferences in 1949, highly significant differences between the two populations are found by means of the chi-square test. To conclude that preferences have changed in the two periods, however, would ignore two fundamental limitations: (1) One must assume that changes in preferences

are not due to changes in the population; (2) The sample surveys of the two periods are assumed to provide unbiased estimates. If these two assumptions are acceptable, then changes in preferences are indicated, fewer preferring brown shells.

Table 9. Shell Color Preferences for 1940 and 1949

	1940		1949		Percent of those responding 1940	Percent of those responding 1949	Percent of those having a preference 1940	Percent of those having a preference 1949
No preference	411		244		52.5	49.2	52.5	48.5
Have a color preference	367		252		47.5	50.8	--	--
Prefer white		120		131			15.3	26.0
Prefer brown		251		114			32.1	22.7
Prefer cream		2		7			.3	1.4
No answer	5		7				.7	1.4
Total	783		503		100.0	100.0	100.0	100.0

Yolk color preferences

Any factor that is desired by consumers may be of importance in grading. Morse implies that yolk color is a factor to be considered in establishing grades.[1] With this in mind, respondents were asked if they preferred a yolk color for frying or poaching, for custards, or for baking. The results are shown in Table 10.

[1] Morse, R. L. op. cit. pp. 161-168.

The chi-square test was applied to the data of Table 10. The null hypothesis that there are no differences in preferences for the different uses is not rejected on the 5 percent level of significance. Highly significant differences for yolk color preferences are found by means of the chi-square test when comparing Morse's data obtained in 1940 with the 1949 data.

Table 10. Preferences for Yolk Color for Different Uses

Type of answer	Frying or poaching		Custards		Baking	
	No.	Percent	No.	Percent	No.	Percent
No preference	158	31.4	181	36.0	187	37.2
Light	63	12.5	54	10.7	52	10.3
Medium	112	22.2	102	20.3	104	20.7
Dark	78	15.5	82	16.3	83	16.5
Bright yellow	20	4.0	15	3.0	14	2.8
Deep yellow	47	9.3	46	9.2	41	8.2
Don't use for	--	--	4	0.8	3	0.6
Yellows	17	3.4	10	2.0	10	2.0
Not asked	4	0.8	4	0.8	4	0.8
No answer	4	0.8	5	1.0	5	1.0
Total	503	99.9	503	100.1	503	100.1

Aside from the question of comparing two surveys in two time periods, however, a comparison between the two surveys must be limited by a difference in technique that was used for obtaining observations. Morse used a color chart to observe yolk color preferences, and implied that the validity of his findings was questionable since the relative positions of colors used in the color chart were

observed to effect responses on color preferences.

Morse stated that extreme colors, either light or dark, were least preferred. This is not significantly shown in the above findings. There is more of a tendency for preferences for the medium and dark colors. In so far as the Des Moines market is concerned, this is no problem since the color of the yolk is a function of what is fed. Birds fed on the range will produce darker colored yolks than birds fed feeds containing less yellow pigment, and therefore Iowa yolks will be predominantly dark. The preferences of Des Moines respondents for the darker colors are apparently the result of their being accustomed to the darker yolks produced in Iowa. Preferences for lighter yolk colors in eastern markets might similarly be found.

What Consumers Say They Look For When Buying Eggs

Supplementary to direct questions on particular preferences, respondents were asked what was the first thing they looked for when buying eggs. This was an open-end question, note being made of pertinent remarks made by respondents. The results are presented in Table 11.

Shell color holds a minor position in contrast to size and quality factors. Quality (which includes freshness and cleanliness) is referred to by 25.5 percent.

Price (i.e., in the sense of relevant prices as experienced in the past by the respondent) holds a surprisingly minor position which may partially be accounted for in the hesitancy of respondents to admit that price would influence the purchase of such a minor commodity as eggs. Moreover, price in this instance might have been accepted by respondents as beyond control, and therefore did not have to be mentioned.

Table 11. What Consumers Say is the First Thing They Look For When Buying Eggs

What is looked for	Number	Percent
Nothing	23	4.6
Size	216	42.9
Price	23	4.6
Freshness	75	14.9
Cleanliness	35	7.0
Quality and grade	18	3.6
Reliable sellers	28	5.6
Other (includes uniformity of color, etc.)	52	10.3
Shell color	19	3.8
Not asked or no answer	14	2.8
Total	503	100.0

THE MERIT OF SURVEY DATA FOR ESTIMATING HOW MUCH RESPONDENTS WILL PAY FOR PREFERENCES

It will be recalled that the value of a utility function is determined by the quantities of commodities in the possession of an individual. (This is subject to the constraint of a given income distribution and technological transformation function.) If one of the n commodities is eggs, and if the eggs are defined as of a particular quality, the utility function can be maximized only if the individual is able to obtain the desired quality, *ceteris paribus*.

In the preceding pages, estimates of consumer preferences were presented. The existence of these preferences can now be related to what is sold in Des Moines in order to estimate the efficiency with which eggs are marketed. But such estimates of efficiency would be subject to two conditions: (1) Respondents are willing to pay for these preferences. (2) The amount respondents will pay for these preferences would warrant sellers responding. Obviously, a study which has only observations on the consumer level cannot take into account the second condition. It must be assumed that sellers are able to respond; the only reason that they do not respond is due to lack of knowledge. The following discussion will be concerned,

therefore, with the first condition; in particular, the validity of using survey data for determining an answer to the first condition.

Previous Studies Using Survey Data for Estimating the Relation Between Quality and Price

One of the first and most impressive studies using survey data for observing the relationship between quality and price was made by Waugh.[1] Data on vegetable quality and prices were obtained from the terminal market in Boston and analyzed by means of multiple correlation methods. Waugh, in the chapter, "A Discussion of Methods of Measuring Market Demand for Quality,"[2] concluded that the influence of preference factors on prices could be measured quantitatively by using observations obtained in market surveys.

Lindsey and Yount[3] and Gans[4] carried on with Waugh's work by using similar techniques in analyzing the relation of quality and price at the retail level. Cron used

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[1]Waugh, F. W. Quality as a determinant of vegetable prices. Columbia University Press. 1929.

[2]Ibid. pp. 100-108.

[3]Lindsey, A. H. and Yount, H. W. Relation between egg quality and price. Massachusetts Agricultural Experiment Station. Bulletin 282. 1932.

[4]Gans, A. R. Relation of quality to the retail price of eggs in New York City. Cornell (Ithaca) Agricultural Experiment Station. Bulletin 597. 1933.

analysis of covariance to take into account store and season effect when analyzing retail store data.[1] These effects were not as impressively handled by previous investigators.

Morse made the following observation on relating price and quality with data obtained in market surveys:

> A major limitation of the market survey method lies in the over-simplified relationship which is commonly assumed between price and consumers' preference. Actually what is secured by the market data survey method is a picture of consumers' choices in terms of prices, and quantities and qualities taken. Such choices may reflect only roughly their preferences. The market may be so organized that it is difficult, if not impossible, for the consumers to express adequately their likes and dislikes in their market selections. Several conditions may interfere: (1) The range of products offered consumers may limit the extent of their choices. (2) The products may be labeled inaccurately as to their quality. Hence, the consumers in part are unable to compare satisfactorily the qualities offered in the market and intelligently to express their preferences in their choices, and in part are actually misled in their market selections so that their market choices reflect only a limited and perhaps a false picture of consumers' preferences. (3) Consumers' market selections of particular items are not solely a function of the price and the quality of the particular product; the selection is confounded by such other considerations as: store personnel, types of displays, proximity of the store, store services, volume of other goods purchased at the store, etc.[2]

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[1]Cron, L. E. An application of covariance to price-quality relationships of eggs. Journal of Farm Economics. 22 (no. 2):440-445. 1940.

[2]Morse, R. L. op. cit. pp. 93-95.

The observations made by Morse will be pertinent to the discussion that follows.

How Much Respondents Say They Will Pay For Interior Quality Preferences

Respondents, once having identified the eggs last purchased with one of the grades on the preference charts, were asked how much more or less they would have been willing to pay for the other grades relative to the price last paid. In enumeration, it became apparent that responses were affected by current market price differentials. Just as consumers refer to the normal price of soft drinks or candy bars, so did respondents appear influenced by what they felt were normal price differentials relative to what actually existed in the market place at the time the question was asked.

When asked how much they would pay for different grades relative to the egg last purchased, respondents would ponder over the differentials they had seen the last time they bought eggs. Enumerators cautioned respondents that the question referred to what they would be willing to pay for different qualities and did not refer to differentials existing in stores. There was a limit to enumerator prompting, however.

The difficulty with this type of question lies in the

assumption that respondents are able to predict how they would act under varying circumstances. Table 12 presents average differentials consumers said they would pay for their preferences.

Table 12. Price Differentials Consumers Say They Would Pay

	AA minus C	AA minus B
Average differential[1]	10.2	7.6

[1]There were 100 respondents that gave a price differential for AA and C, 131 for AA and B, 150 for AA and A. The different number of responses in each case are the result of some respondents stating they would not buy a particular grade. It is interesting that more were willing to buy the higher than the lower qualities.

The results are not too different from the differentials observed in the price-quality sample made in 47 stores in Des Moines. The store differentials are presented in Table 13.[1]

Table 13. Price Differentials Found in 47 Stores

Grade	Number of stores	Average price	Price differential (compared to A)
A	47	65.1	--
B	21	57.4	7.7
C	5	53.4	11.7

[1]The best eggs the stores sold were defined as grade A, the next lowest price as grade B, and the lowest price as grade C.

Consumers in quoting differentials do appear to be influenced by existing market prices, and this may account for the similarity in results between the consumer and store surveys. On the other hand, it is difficult to believe that consumers are as aware of existing differentials as the above tables suggest.

Prices Paid as a Measure of Shell Color Preferences

Since there is a question about consumers being able to state how much they would pay for desired qualities, it would appear logical to note how much respondents actually did pay relative to their preferences. Table 14 presents the average price paid for eggs by those having a shell color preference and those without a preference.

Except for cream color, the prices are nearly equal.[1] However, this is deceptive. Since there are other factors[2] interacting on the prices of Table 14 which are not considered, there actually is no evidence that respondents, although stating a preference, will or will not pay more

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[1]The reason for higher prices for cream color shells is discussed in Appendix D. The evidence indicates that location of the store is an important factor in the pattern of higher cream prices.

[2]"Other factors" refers to those mentioned in the succeeding discussion and also includes the factors mentioned by Morse. Cf. pp. 52, this thesis.

for that preference. For example, within a store, a favored color might have a slightly higher mark-up than another color, but the size factor might offset the color factor enough to equate the prices. That is, a white color ordinarily might be priced two cents higher than a brown, but if the brown is slightly larger, the prices might be the same. This would also be true if other preference factors were brought into the analysis.

Table 14. Average Price Paid by Those With and Without Shell Color Preferences

Response	Number	Mean price
No preference	244	52.4
Preferring whites	131	53.1
Preferring browns	114	53.6
Preferring creams	7	57.5
Total	496[1]	

[1]No information for seven respondents.

Similarly, since the observations of Table 14 are aggregates for the city, store type and location are not taken into account. The pricing differences among stores among locations may offset each other in such a way that the aggregate prices are similar.

Nor can it be ignored that there is no reason to have one price higher than another if the quantities of different

colors supplied are sufficient to offset either higher or lower demands for the respective colors.

Aside from Morse's observations mentioned above, some of these limitations to a meaningful analysis of survey data, such as are found in Table 14, can be minimized. If color of shell is offset in price by size, the size factor can be held constant. Observations in this case would more handily be obtained in a retail store survey than in a consumer survey. As was seen in the study by Cron, store type and location effects could be handled by analysis of covariance. But it would appear to be impossible to take into account the effect of the supply of the preference factors that are analyzed. To repeat: regardless of the preference pattern (that is, regardless of the differences in the demand schedules for the various qualities), the supply schedules of the respective qualities may offset the higher or lower demands to the extent that the prices paid for the different qualities are in no way related to preferences. Regardless of whether consumer of retail price data are analyzed, variation in quality can be related to variation in prices only if the supply of the quality variations can be accounted for.

This conclusion may not be readily apparent. To demonstrate the point that is made, it may be of aid to present an example. Let it be assumed that model (4)

presents a logical relationship between price and the designated variables.

$$y_{ijk} = u + l_i + s_j + c_k + e_{ijk} \qquad (4)$$

where: y_{ijk} = price of eggs in the ith location, for the jth store, for the kth color

u = over-all mean effect

l_i = location effect (for the ith location)

s_j = store type effect (for the jth store)

c_k = shell color effect (for the kth shell color)

e = residual error

The model, (4), states that the variation in the price of eggs is associated with the mean effect, the variation in location, store type, shell color and residual error. It is assumed (other than the assumptions ordinarily associated with analysis of variance) that price is an indicator of the value consumers place on preferences and is also a continuous measure of grade. Moreover, a condition of ceteris paribus is assumed in so far as the effect of other preference factors on price is concerned. The validity of this assumption may be open to question, although it is not a severe limitation if the variation in the other preference factors is held constant. However, a most fundamental assumption in (4) is that quantities of different shell colors do not offset price differentials

consumers pay for the colors.

Let it be assumed that the hypothesis to be tested is that shell color preferences are not associated with price differences. The hypothesis may or may not be true. The question to be resolved is whether or not the survey technique can provide data from stores (or households) which can be analyzed relative to the hypothesis. The remainder of this section will be involved with proving that it cannot.

A survey necessarily provides observations in one point in time. Observations can be obtained from households or stores, but only one is made in each store on each day. Each observation represents supply and demand conditions at the time the survey is made. The difficulty, however, is not in the demand condition, since this can be assumed as essentially stable, but rather in the supply picture.

If the demand for each quality remains the same, but the supply of the qualities fluctuates to such an extent that at any one time period the prices of all qualities are the same or even inverse to the usual condition, then a survey cannot provide data which can meaningfully test the hypothesis suggested above.

It is not an unusual case to have a condition in which supply and demand are such that no price differences exist

among different qualities of the same commodity. For example, although this is not the general case, in New York City where premiums are usually paid for white shell colors over brown, within the last two years prices quoted for white shell eggs have been two cents below the less preferred brown shells. Equally important is the fluctuating supply not only in the variations of one quality factor but in the relative supply of variations of other preference factors of the commodity itself.

The implications of this, from an economic point of view with regard to the above analysis, are obvious. Even if the effect of shell color preferences on price had been insignificant in model (4), shell color preferences could still have existed. The variation in prices that exist at the time the survey is conducted may be the result of the supply condition of the variable (quality variation of the preference factor) studied or the supply conditions for any other associated variables. No analysis of survey data can cope with the effect of the supply effect.

It is possible under (4) to assume that the variation in prices existing at the time the survey data were gathered were "average" differentials, existing more or less throughout the year. But this assumption ignores the major weak-

ness in the analysis of the data.[1]

The experimental method[2]

The experimental method on the retail level, where different preference factors and price are arbitrarily altered, holds some hope for answers to the problem of the monetary significance of preferences. By this technique, actions of consumers under actual conditions in the store can be observed, prices and different factors being altered at will, and any questions on the subjective responses or on the confounding of data by exogenous variables need not enter the analysis. Most important, the effect of the supply of any one factor or group of factors is controlled since price differentials are arbitrarily decided upon without reference to supply.[3]

[1] If the supply and demand functions were known, it might be possible to correct survey data taken in one time period or over time for fluctuations in supply. This would assume a knowledge of the quantity supplied by producers to consumers.

[2] Jessen explains the difference between the survey and experiment as follows: "The essential difference between the survey and experiment for determining cause-and-effect relationship is that in the experiment the investigator exercises control over when and which investigative units a given factor (or treatment) whose "effect" is under measurement will be put. It is the exercising of this control that we may call experimenting. Where we don't exercise this control in our investigating (either because we can't or don't choose to), we are surveying rather than experimenting." op. cit. pp. 1-5 to 1-6.

[3] Morse came to the same conclusion for different reasons although he did not state specifically the design he had in mind other than that it would be like a plot experiment used in the physical sciences. op. cit. p. 97.

Essentially the same model as (4) can be used in an experiment. However, instead of considering shell color as a treatment, price differentials for different variations of the same preference factors may be considered the treatment. For example, the model (5) could be used to examine the influence of different price differentials for interior quality, all preference factors held constant.

$$y_{ijk} = u + d_i + s_j + p_k + e_{ijk} \qquad (5)$$

where: y_{ijk} = quantity disappearance of interior qualities A, B, C for the ith day, the jth store, the kth price differential

d_i = day of the week effect (for the ith day)

s_j = store type effect (for the jth store)

p_k = price differential effect (for the kth price differential)

e = residual error

In this case, to take into account day of the week and store effects, a latin square design may be used in which stores are rows and days are columns.[1] Stores could

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[1]Doctor Max Brunk and his students have two excellent publications on the use of the latin square design in preference analysis.

Cf. Dominick, B. A. An illustration of the use of the latin square in measuring the effectiveness of retail merchandising practices. Cornell University. Methods of Research in Marketing. Paper number 2. 1952.

Henderson, P. L. Application of double change-over to measure carryover effects of treatments in controlled experiments. Cornell University. Methods of Research in

be selected on the basis of location, merchandising techniques, size and volume, the number of stores being equal to the number of treatments. Days of the week might be divided according to numbers of customers and treatment numbers.

Consumers entering selected stores would find selected price differentials existing for the variations in the preference factor. Other than the factor studied, it would not be necessary to have any variation in any other factors. That is, to study interior quality preferences, interior qualities A, B, C, could be clearly defined by plastic models or pictures.[1] Consumers could be told that, of

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Marketing. Paper number 3. 1952.

Another paper, of a more general nature, discusses the latin square design as a technique for analyzing merchandising methods. Cf. Burrows, G. L. An experiment in marketing. Agricultural Economics Research. 4 (no. 4):128-135. 1952.

The design suggested in the main body of this thesis is essentially the same as the basic design used by Dominick with the exception that sales of three variations of one factor are the responses observed in each cell, and that price is the treatment rather than merchandising techniques.

[1] The Poultry and Egg National Board appears to have an answer to the problem of having to use photographs to display interior quality. The P.E.N.B. has plastic models of the interior quality of eggs which are remarkable duplicates of actual eggs as they would appear broken out of the shell.

these qualities, everything else was the same except the price.[1]

The question may be raised on how answers from such "artificial" experiments can be applied to an actual economic situation. The implications in this question can be raised, of course, against any controlled experiment that deviates an iota from actual conditions. It may well be that such criticism is valid. However, what is desired in the case discussed is how consumers will react under "ideal" conditions -- i.e., under conditions of perfect knowledge about their purchase. Under a "perfect" grading system, the condition of perfect knowledge would exist. To that extent, the results from such an experiment would be meaningful.

It should be stated that it does not seem essential to limit the number of treatments to a small number. It may be possible to vary several preference factors to note their effects on quantities purchased. For example, of four variations in colors in the sale of a dozen eggs, there would be six possible combinations of paired colors. (Pairing is essential in determining how much will be paid

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[1]Complications do enter. Stores must be so located as to prevent consumers from being indifferent about going a few stores away to buy eggs. In addition, differentials of a high price period would have a different effect in purchases of different qualities than the same differentials in a low price period.

since consumers must be faced with at least an alternative selection.) If four price differentials are used -- e.g., 2 cents, 5 cents, 10 cents, 15 cents -- then there are 24 possible combinations of prices and colors. And if three sizes are used, there are three combinations of sizes taken two at a time, meaning that there are 72 possible paired combinations of four colors, four prices, and three sizes. Add to these combinations three interior qualities, and there are 216 possible paired combinations. This assumes type of carton and yolk color as constant.

Although it is not necessary to use all possible combinations, the number of paired treatments would be large. This points to the use of an incomplete design. Suggested designs for examining how much consumers will pay for preferences for one quality factor (as in model (5) above) and for the case in which several quality factors are examined simultaneously, are presented in Appendix E.

PREFERENCES AND SOCIO-ECONOMIC FACTORS RELATED TO SOURCES OF SUPPLY

For a commodity such as eggs, the pricing mechanism can be particularly ineffective in reflecting consumer preferences. One reason for this is that eggs, generally speaking, appear to be of no more importance in the minds of sellers and buyers than any one of a number of other foods. In comparison with a commodity such as meat, eggs may be given only comparatively minor consideration.

Of those respondents buying eggs at retail stores, about 80 percent bought eggs with their groceries. It is apparent that for many respondents, other factors, such as the convenience of purchase of all groceries, may tend to minimize the importance of preferences within the commodity itself. Under this condition, sellers of eggs cannot be provided with a clear-cut indication of consumer preferences.

The importance of a commodity, assuming an element of competition, is also closely reflected in the operation of a store. The profit incentive tends to promote an attraction mechanism -- e.g., a display -- comparable to the importance of the commodity providing the profit. In so far as eggs are concerned, the attraction mechanism is seldom prominent in the Des Moines market. Distinctive

meat or dairy displays may be found, but seldom is there a comparable egg display. Retail merchants, alert to consumer desires in a general way, evidently have not found it necessary to provide prominent merchandising techniques for eggs.

The purpose of the following analysis is to attempt to observe the importance of different factors that determine where and why consumers buy eggs at a particular source. Price and income factors will be examined. Since preferences for interior quality have been established, interior quality will be related to source of supply in order to estimate the reflection of preferences and the part that quality plays in determining where eggs are bought.

Sources of Supply

Respondents in the major sample were asked where they generally bought their eggs. Responses are presented in Table 15.

Most significant in this table is the large percent of respondents buying eggs directly from producers. If producer purchases include eggs bought from producers and eggs delivered at place of work, then about 34 percent of

Table 15. Where Eggs are Generally Bought[1]

Source	Number	Percent
Any place	12	2.4
From producer	161	32.0
Grocer or butcher	153	30.4
Supermarket	46	9.1
Corporate chain	71	14.1
Poultry market	18	3.6
Milk dealer	3	.6
Huckster	2	.4
At place of work	9	1.8
City market	4	.8
Miscellaneous	3	.6
Produce own	12	2.4
Produce own and buy	2	.4
Uses no eggs	2	.4
Not asked	3	.6
No answer	2	.4
	503	100.0

[1] When asked, "Where did you last purchase eggs?", respondents in 1940 named the following sources of supply: Grocer (53 percent), producer (21 percent), huckster (13 percent). This same question was asked in 1949. Sources were as follows: Grocer (57 percent), producer (31 percent), huckster (.2 percent). Although one must be careful about comparing the two studies, there is some logic in the results. In a relatively high farm income period such as 1949, fewer farmers might have the incentive to be hucksters than in 1940; consumers desiring "fresh farm eggs" would be forced to go to the farmer.

the households in Des Moines purchase eggs from producers.[1] If eggs are purchased from these producers because of dissatisfaction with eggs sold by retail stores, then there is good reason to question the efficiency with which eggs are marketed in Des Moines.

Reasons for Buying Eggs from Producers

Table 16 presents reasons given by respondents for their purchases of eggs from the farm rather than nearby retail stores.

Table 16. Why Respondents Did Not Buy at Store

Reason	Number	Percent
Don't know retailers	20	12.4
Price	33	20.5
Fresh	78	48.4
Habit	2	1.2
More convenient	7	4.3
No information	21	13.0
	161	99.8

[1] Other consumer studies indicate that the above general condition on sources of supply for urban consumers is also similar for other large cities in the midwest. For example, this was true in a study in Minneapolis by Waite and Carrol. Egg buying by consumers in Minneapolis. Farm Business Notes. University of Minnesota. Number 304. 1948. Fifty percent bought farm eggs in this study. It was also true for studies made by Stevens in Ohio (60 percent) and Tupper and Harris in Peoria (29 percent). Cf. Stevens, H. F. A survey of poultry and egg marketing in Richland County. Part I - Consumer and retailer phases of the study. Ohio Agricultural Extension Service. Processed, 1947. Tupper, G. E. and Harris, J. R. Consumer egg buying habits in Peoria, Illinois. Bradley University Business Study Number 1. 1950. p. 11.

Three responses stand out in Table 16: (1) 12 percent did not buy at nearby retail stores because they did not know the retailer; (2) 20 percent considered store prices to be too high; and (3) 48 percent thought that store eggs were not as "fresh" as those of producers.

It is not unreasonable to interpret "not knowing the retailer" as synonymous in many cases with lack of faith in the retailer. This, in turn, is related to price and quality. The purchase of commodities from sellers (disregarding the personal likes and dislikes for the retailer, although this is undoubtedly involved in the response) is in general terms a function of the prices paid and the quality received. Egg quality to the buyer may be considered an unknown variable among and within stores in Des Moines, considering the lack of any uniform grading system in the city, unless previous purchases at a particular source by the housewife have shown that small variations exist in quality.

Undoubtedly previous purchases and comments by neighbors are involved in the responses of those stating a distrust for retailers, distrust presumably relating to both price and quality. But even if it is ignored that quality may be involved in the distrust of retailers, 48 percent of the respondents pointedly referred to quality in the form of "freshness" as a reason for not buying from stores.

A small but still sizable portion made note of the price factor. The importance of price relative to quality factors is difficult to analyze since the two factors are not independent of one another.

Patronage Loyalty

Before looking at the influence of price and quality factors on where eggs are bought, patronage loyalty of consumers will first be observed as an indication of satisfaction with the value[1] received from different sources of supply.[2] Table 17 shows the number and percent that bought at one source only.

Table 17. Those Buying Eggs from One Source Only

Source	Number	Percent
Farm	102	37.8
Indep. grocer	90	33.3
Vol. chain or indep. supermkt.	25	9.3
Corp. chain	27	10.0
Poultry market	10	3.7
Other	16	5.9
Total[1]	270	100.0

[1]Total buying eggs from stores is 158.

[1]Value, as used herein, is synonymous with the term "bargain," used by laymen. A bargain includes relative prices and quality.

[2]In the case of buyers of store eggs, it cannot be ignored that the buyer is maximizing his position by buying eggs at a source providing other goods as well as eggs.

Of 161 respondents generally buying eggs from producers, 102, or 63 percent, bought eggs from only one producer. Of 269 respondents buying eggs from retail stores, 158, or 53 percent, bought eggs from one store only and no other place.

In further estimates of patronage loyalty to types of sources, 75 percent of the respondents generally buying eggs from producers continued to buy eggs only from producers. Of 127 generally buying eggs from grocery stores as well as other sources, 61 percent continued to buy only from other grocery stores.

That buyers of producer eggs are more loyal is further substantiated with answers to the question, "Where did you get the best eggs?" This question was asked of those buying eggs from both farmers and grocery stores; 68 percent thought that farm eggs were better than eggs from other sources.[1]

The Price Factor

The influence of price, alone, as related to different

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[1]From data collected in 1940, if hucksters are classified as producers, 40 percent of the respondents thought producer eggs were the best.

The psychology of liking farm eggs better than store eggs is evident in these responses. There may be an emotional bias above and beyond the question of preferences, as such, in the response that farm eggs are better than eggs from other sources. Taking the psychology of farm purchases into account, it can be argued that source is a preference factor that confuses a simple economic analysis.

sources of supply will now be examined. Table 18 presents average prices paid by respondents at three distinct sources of supply.

Producer prices averaged about 13 cents lower than grocery store prices; more specialized sources averaged about 5 cents lower than grocery store prices. This would appear to indicate that price was an important factor in determining why 34 percent of the respondents bought eggs directly from producers.

Table 18. Mean Prices Paid at Three Main Sources[1]

Source	Number	Mean price
Producer	161	42.8
Grocer[2]	274	56.2
Specialized source[3]	21	51.6

[1]In the 47 retail stores, prices ranged from 53 to 71 cents with a mean of 65.1. These prices are only for the "best eggs." Other prices of lower grades ranged from 39 to 67 cents with an average of 57.4 cents.

[2]The term "grocer" includes small independents and supermarkets with no reference to type of integration.

[3]Includes poultry market and milk dealer.

Prices of Eggs Bought Separately and with Groceries

About 80 percent of the respondents buying eggs from stores bought groceries at the same time. The convenience

of such purchases might well be an explanation of the higher prices paid for store eggs.[1]

To observe the relationship of the price of eggs to the purchase of eggs with and without groceries for the above types of stores, average prices for the two categories were computed. Those buying eggs with groceries paid an average price of 56 cents; eggs bought separately from groceries had an average of 54 cents. The prices paid for the different methods of buying eggs at different stores are presented in Table 19.

Table 19. Mean Prices Paid at Different Stores

Source of purchase	Buy eggs separately	Buy eggs with groceries
All stores (weighted)	54.0	56.2
Small indeps.	53.2	54.8
Supermarkets	54.3	58.4
Corp. chain	58.0	57.9

There does not appear to be any significant difference between the prices paid by the two groups. It can be concluded that for those buying eggs from stores, the convenience of purchase of eggs with groceries does not necessarily mean that consumers pay higher prices for eggs than

[1] Cf. Black, G. Variations in prices paid for food. Journal of Farm Economics. 34 (no. 1):65-66. 1952.

those buying eggs without groceries. Price does not appear to be an influence in this respect with buyers of store eggs.

Income and Consumption Related to Source of Supply

To investigate further the influence of price on where eggs were bought, the incomes of those buying at the two main sources of supply were analyzed. Since producer eggs are cheaper, the incomes of those buying from producers would logically be expected to be lower than the incomes of those buying from stores, ceteris paribus.[1] The total incomes of buyers of producer eggs averaged 78 dollars per week while buyers of store eggs averaged 75 dollars per week. Table 20 presents the incomes of those buying from the two main sources of supply.

There is a tendency for a larger proportion of the middle incomes to buy eggs from producers.[2] This would be logical since lower income groups could not afford the transportation to buy from producers.

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[1]Cf. Norris, R. J. The theory of consumer demand. Yale University Press. 1947. Norris states that ". . . the poorer the consumer, the more surely he will take careful thought in making his outlays." pp. 68-69.

[2]This was also observed by Lininger and Charles. op. cit. p. 11.

One might expect that families consuming larger amounts of eggs would make purchases at the lower priced source, ceteris paribus. The average consumption of those buying eggs at the farm was compared with those buying eggs at the store. No significant difference was found, although the group averages were in agreement, in an ordinal sense, with what was expected. The average consumption of families buying from producers was 24 eggs per week while the average consumption of families buying from stores was 23 eggs.

Table 20. Source of Supply and Total Income

Total weekly family income (dollars)	Source			
	Farm		Store	
	No. of households	percent	No. of households	percent
0 - 34	8	5.2	36	12.7
35 - 54	33	21.4	54	19.3
55 - 74	30	19.5	49	17.5
75 - 94	34	22.1	54	19.3
95 and up	49	21.8	87	31.0
No information	7	4.5	8	2.9

It may well be that the income effects resulting from lower prices at the farm are too small to expect clearly defined "rational action" in the purchase of eggs alone. Were eggs a major cost in the food bill as is true of meat, lower prices (assuming eggs to be the same commodity at the two sources) might tend to promote more purchases at the farm by those with larger families, larger consumption,

and lower incomes. More than likely, the extra cost and bother in buying eggs at the farm is a serious deterrent to purchases by many in the lower income brackets.

Interior Quality at Different Sources

An attempt was made at establishing interior quality purchased from different sources by means of the same photographs used for determining interior quality preferences. Respondents were asked which egg on the chart looked most like the eggs they last used.[1] Table 21 presents source of supply related to the interior quality respondents claimed they last used.

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[1]The problem of response bias that enters this technique is discussed intensively in Appendix F. Briefly, the problem involves the dependence between the question on the ordering of interior qualities and the next question which required the respondent to identify the interior quality last bought with the different interior qualities on the chart. In addition, the above discussion on interior quality supplied by different sources is completely dependent on the ability of respondents to remember and identify the interior quality last purchased. With regard to these two major points on response bias: Dependence between responses does not affect the value of the above analysis. If the responses are correlated, the analysis is still valid. As a matter of fact, one might expect buyers of a particular quality to prefer that quality, believing it to be the "best." The problem of respondents remembering what interior quality had been purchased the last time is open to question, and is discussed in Appendix F. Some respondents may have erred in their selection of interior quality last purchased. This must be accepted. But this would be equally true of those buying from farms as well as stores. There is no reason to suspect that responses of one group are any more biased in one direction than the responses of the other group.

Table 21. Interior Quality Claimed by Respondents and Source of Last Purchase[1]

Egg last used	Source									
	Producer		Small indep.		Supermarket		Corp. chain		Total	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
AA, A	94	67.6	70	50.0	20	54.1	33	52.4	217	57.3
B	4	2.9	11	7.9	6	16.2	8	12.7	29	7.7
C	41	29.5	59	42.1	11	29.7	22	34.9	133	35.1
Total[2]	139	100.0	140	100.0	37	100.0	63	100.0	379	100.0

[1]In the sample of 47 stores, 21 percent of the eggs were graded as A's, 60 percent as B's, and 19 percent as C's. This does not agree with what respondents claimed they received. Assuming that the two samples provided an unbiased estimate, the two samples might not agree since consumer responses might be influenced in a general way by purchases of a previous time span and not just the last purchase.

[2]This is a total of those making a selection.

The chi-square test was applied to the data of Table 21. The null hypothesis that there is no difference in the grades of the two sources, farm and store, is rejected on the 1 percent level of significance. If the technique for observing qualities sold by different sources is accepted, it can be concluded that farm eggs are of a higher quality than store eggs. However, the null hypothesis that there is no difference in quality among stores is not rejected on the same level of probability.[1]

Preferences Retailers Believe Exist[2]

In the sample of 76 stores, retailers were asked the following questions:

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[1]The method of handling eggs on display was related to types of stores. Large supermarkets had a significantly larger number of eggs under refrigeration than smaller independents. Under these conditions, ceteris paribus, supermarkets would be expected to have higher quality eggs. This was not found in the household data or in data obtained from the survey of 47 stores. Evidently the quality of eggs was not the same prior to sale on the retail level.

[2]The observations in this section were obtained from a sample survey not discussed previously. The sample was drawn from a list of stores in Des Moines which was supplied by the secretary of the Des Moines Retailer Grocer Association. Store types were drawn at random proportionate to their occurrence in the major sample of 503 households.

(1) How would you rank the eggs on this chart from best to poorest?[1]

(2) How do you think customers rank the following factors in order of their importance when they buy eggs?[2]

The first question on the ranking of interior quality was asked as a method of observing the relationship between preferences of consumers and preferences of retailers. The implied purpose of the question was to test the reflection of consumer preferences. Rank correlation was used in the analysis. Retailers were not in significant common agreement on any differences between AA and B. On the 5 percent level of significance, retailers were in agreement on the following ordering of preferences: A over AA (or B) over C. Since A is similar physically to AA, and since B differs markedly compared to A and AA, the responses of retailers were inconsistent. Therefore, the selections may be of no value. But the selection of A as the top grade and C as the lowest grade would indicate some

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[1] Retailers were shown the same photographs of interior quality with profiles that were used for determining consumer preferences.

[2] Retailers were shown one of five cards on which the following five factors were indicated: cleanliness, kind of carton, broken out quality, shell color, size. Five cards were used in which the position of each quality factor was rotated. The cards were shown to retailers so that every fifth retailer saw the same card.

degree of awareness of quality preferences of consumers. A limitation on any conclusion is whether preferences of retailers are independent of consumer preferences.

Sixty-four retailers answered the second question. Rank correlation analysis indicated significant common agreement on the following ordering of the factors: size was most important followed in decreasing order of importance by cleanliness, interior quality, shell color, and kind of carton.

It will be recalled that Table 11 on page 49 presents the first thing respondents look for when buying eggs. Retailer responses on what consumers look for are in agreement with the ordering of consumer responses of Table 11, although retailers apparently stress cleanliness more than consumers. One might therefore conclude that the pricing mechanism is reflecting preferences to producers. This conclusion, however, is limited by a major consideration: when asked what was the first thing looked for when buying eggs, respondents gave answers that were influenced by the present method of marketing eggs. Therefore, if sellers thought size was the most important factor in the minds of consumers, then eggs would be graded on the basis of size, and consumers would tend to buy eggs on the basis of the size factor. In other words, the relation between what consumers look for when buying eggs and what retailers be-

lieve they look for is little more than an observation on how each group adapts itself to present marketing conditions. This is a question of cause and effect -- i.e., whether or not the utility function determines what is produced. When imperfect knowledge exists in a market on the part of both buyers and sellers, the utility function and entrepreneurial decisions on what to produce will interact, neither being a cause nor an effect.[1]

This is really the crux of the problem at hand: if the pricing mechanism does not reflect consumer preferences to producers, then both groups merely adapt themselves to the imperfect situation in which the utility function cannot be maximized. Under such circumstances, the imperfect condition tends to remain, changing slowly as knowledge about the condition increases.

If it is assumed that the utility function of consumers determines production, then there is evidence from the sample of 76 retail stores that the pricing mechanism reflects preferences to secondary producers. On the other hand, this would deny any reason for 34 percent of the respondents buying eggs from farmers. Prices of farm eggs were not only lower on the average by 13 cents, but also appear to

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[1] This is the problem of "consumer sovereignty" and the extent to which it exists. Cf. Norris, R. T. op. cit. pp. 61-74, or Hildebrand, G. H. Consumer sovereignty in modern times. American Economic Review. 41 (no. 2):19-33. 1951.

have been of higher quality. Consumers were certainly maximizing their positions by buying eggs at the farm. But this does not mean that the marketing of eggs was efficient in the sense of maximizing the utility function. Other things being the same, a market would be at the maximum point of efficiency when purchases of eggs are made at the nearest source of supply. This is certainly not the case in Des Moines.

RECOMMENDATIONS FOR IMPROVING THE EFFICIENCY OF EGG MARKETING

A market is defined as efficient if under no other arrangement (given the technological transformation function and income distribution of the society) can consumer satisfaction from the consumption of eggs be increased. Since 34 percent of the consumers in Des Moines were buying eggs from producers, one might suspect that the utility functions of consumers were not maximized. In other words, consumers attempted to obtain greater satisfaction by turning to producers for their eggs because stores did not provide comparable values, comparable value being represented by a price that compensates for quality differences (ignoring other subjective and psychological factors that may be involved but which cannot be estimated in survey data.

Consumers purchasing eggs in stores in Des Moines present a more complicated question than that presented by those buying eggs from producers. About 80 percent of the respondents buying eggs at retail stores bought other groceries with their eggs. Rather than go out of their way to buy more satisfactory eggs, many respondents evidently were willing to accept "inferior" eggs and be compensated by other factors such as the convenience of buying all groceries at one location. While the purchase

of all groceries in this manner may provide a total satisfaction greater than can be obtained by buying all groceries at any other source, the satisfaction derived from the purchase of one good -- eggs in this case -- may be less than if the one good were obtained from a more satisfactory source.

This is an important consideration since, ignoring the inconvenience of buying at different sources, the actual total satisfaction derived from buying all commodities at one source may be less than the total satisfaction that could be derived by making purchases of individual commodities at several sources. This is little more than saying that if sellers respond perfectly to consumer preferences for each and every commodity, consumer satisfaction will be at a maximum. If sellers do not respond perfectly, consumers can only attempt to reach the most preferred position under the given situation. To repeat: if the satisfaction derived from the actual purchase and consumption of any one unique good is not at a maximum when all goods are bought together (i.e., the utility function is not maximized), the marketing of that good is relatively inefficient.

The remainder of this study on marketing efficiency will attempt to supplement the analysis of the reflection of preferences by presenting methods for maximizing the

utility function. This will be done by examining consumer actions and personal consumer observations on the method of marketing eggs. By this technique further indications of the degree of marketing efficiency will be presented along with methods for increasing the efficiency with which eggs are marketed.

Dissatisfaction with Egg Purchases

Of 480 respondents, 154 stated they had difficulty in buying the quality desired.[1] Of this number 26 percent bought eggs from producers and 34 percent bought eggs from stores. When respondents were asked if they had bought any eggs in the last month that they would have preferred not to use, (this has a stronger connotation than having difficulty buying eggs), 15 percent replied in the affirmative.[2]

Table 22 presents the number of respondents who, in the last month, bought eggs they would have preferred not to use and where the eggs were obtained.

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[1] In 1940, only 11 percent stated a difficulty in buying the quality desired. Ceteris paribus, consumers in 1949 might be considered more discriminating.

[2] A similar proportion, 18 percent, was found in Morse's survey in 1940.

Independents are notably mentioned as providing unsatisfactory eggs in this case. Relative to producers, retail stores as a whole provide a much higher percent of unsatisfactory eggs although the larger sellers appear to provide higher quality than smaller independents.[1]

Table 22. Unsatisfactory Eggs and Their Source

Source	No. dissatisfied	Total No. of each source	Percent dissatisfied of each source
Producer (farmer)	10	161	6.2
Small independents	45	153	29.4
Vol. chain, supermkt. and corp. chain	16	135	11.9
Total	71	449	

Consumer reaction to unsatisfactory purchases

Of those complaining about eggs purchased from stores, 20 percent stated they did not continue to buy anything at the same place; 5.4 percent stated they continued to buy at the same place but did not buy eggs there any more. The remainder continued to buy at the same place either because the retailer made a refund, the respondent had a charge account at the store, or else it was accepted that un-

[1] In 1940, over 95 percent of those buying eggs they would have preferred not to use, bought eggs at retail stores. In 1949, 81 percent of those buying similarly unsatisfactory eggs bought those eggs at retail stores.

satisfactory eggs are to be expected "now and then."

Regardless of whether or not consumers continue to buy at the same place, after having purchased unsatisfactory eggs, it is difficult to deny that the consumption and demand for eggs must be adversely affected by such purchases.[1] A major imperfection can result if sellers are not directly informed of unsatisfactory purchases since dissatisfaction can then only continue to accumulate without any knowledge on the part of sellers.

Why Consumers Do Not Buy Eggs at the Nearest Source

All other things being the same, it might be expected that consumers would buy desired commodities at the source of supply nearest their homes. Respondents were asked why, if there were stores between their homes and where they usually bought eggs, eggs were not bought at these stores. Their reasons are presented in Table 23.

For the group as a whole, major reasons for not buying eggs at the nearest store were distrust of retailers, high prices or poor quality. Only 6.5 percent mentioned convenience. Convenience in this case includes such factors

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[1] Waite and Carroll presented a similar observation in a study in Minneapolis where it was found that demand would be increased if consumers received higher quality. Cf. Waite, W. C. and Carroll, G. op. cit. p. 1.

as the ability to buy all groceries including eggs at one place, parking space, and delivery service. The major reasons given by those buying from producers are quality and price.

Of those buying at stores, about 18 percent did not buy at the nearest store because they "didn't know the retailer." When asked what they meant by "knowing the retailer," many respondents explained that it was a matter of trusting the seller to provide a reliable product at a stated price.

Thus, as was observed with regard to what consumers looked for first when buying eggs, respondents again are shown trying to escape the risk and uncertainty of not getting "what they pay for." Just as eggs are graded by respondents on the basis of size, there being no other quality factor available by which to judge eggs, so are sellers graded on the basis of reliability. Patronage is quite analogous to the grading process. Buyers, by selecting a trustworthy retailer, establish a grade reliability on that retailer such that the risk of undesirable purchases is minimized by patronizing that particular retailer rather than any other.

Advertising of Eggs

Egg advertisements can increase the value of the utility

Table 23. General Source of Supply and Reasons for Not Buying at Nearest Source

Reasons for not buying at nearest source	Where eggs generally bought									
	Producer		Small independent		Vol. chain supermkt.		Corp. chain supermkt.		Others[1]	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Buy at nearest source	16	9.9	79	51.6	22	47.8	25	35.2	3	8.3
Habit	2	1.2	--	--	1	2.2	4	5.6	--	--
Don't know retailer	20	12.4	28	18.3	9	19.6	12	16.9	6	16.7
Stores too small	--	--	--	--	1	2.2	2	2.8	2	5.6
Convenience	7	4.3	13	8.5	5	10.9	3	4.2	2	5.6
Too high price	33	20.4	16	10.5	5	10.9	12	16.9	6	16.7
Poor quality	80	49.6	11	7.2	1	2.2	10	14.1	15	41.7
Not asked, no answer	5	3.1	6	3.9	2	4.3	3	4.2	2	5.6
Total	161		153		46		71		36	

[1] Includes poultry market, milk dealer, huckster, place of work, city market.

function under the following circumstances:

(1) Where the consumer is so influenced that he feels he is better off with advertising than without it.

(2) Where the consumer gains greater knowledge about the commodity or the source where the desired commodity can be purchased.

(3) Where decreasing costs resulting from an increase in the volume of sales provides the consumer with lower prices.

Unless any one of these conditions exists, marketing efficiency can be questioned. If advertising has no effect on consumer knowledge, consumer satisfaction, or a lower cost structure of sellers, then a market with advertising is inefficient.

Competitive advertising among stores selling eggs is common in Des Moines as elsewhere. The belief that eggs hold a minor position in the mind of the housewife led to the hypothesis that advertising of eggs is of little value. From the point of view of costs and returns, this information to an individual seller is important relative to the efficient allocation of advertising funds.

Of those asked where they had last seen eggs advertised, 39 percent replied either that they had not seen eggs advertised, paid no attention to egg advertisements or did not know where the advertisements had been seen.

This is shown in Table 24.

When asked if they could tell the best place to buy eggs by looking at egg advertisements, 8 percent said they could, 65 percent answered they could not, and 21.7 percent replied they did not know.

Table 24. Where Did You Last See Eggs Advertised?

Response	Number	Percent
Haven't seen them advertised	36	7.2
Pay no attention to egg ads	18	3.6
Newspaper	77	15.3
Store circular	7	1.4
National magazine	3	.6
In store	179	35.6
Miscellaneous	24	4.8
Don't know	148	29.4
Not asked, no answer	11	2.2
Total	503	100.0

Respondents were asked why they did or did not know which was the best place to buy eggs, having read egg advertisements. For both types of responses, the majority of the reasons appeared to convey the same impression: either complete or partial hesitancy in accepting egg advertisements as a reliable means to obtaining satisfactory eggs. Undoubtedly this is a reflection of the inability to know fairly well what is being purchased. Under a grading system where a label precisely describes the content, advertising might have more influence on consumers.

Notable was the minor influence of the price factor alone as a guide. This is in keeping with what consumers felt was uncertainty of purchase. Suspicion of misrepresentation is sufficiently apparent that one might conclude that egg advertising in itself is of little consequence. However, the advertisement associated with a known seller appears to be the crucial test of the value of advertising. Since no branding label permits a knowledge of quality, under the uncertain quality conditions in Des Moines, a buyer is forced to determine the quality of egg sold from previous experience with eggs of a seller. Thus, egg advertising for any one seller may be advantageous, but egg advertising by unknown sellers or untrustworthy sellers appears to be completely wasteful.

Labeling

Similarly associated with advertising is differentiation within and among stores by means of brands. For some retailers, differentiation by labeling of highly substitutable goods is a method for establishing grades within a store as well as a method for differentiation among competitors. Whatever the purpose of the retailer, brand differentation in Des Moines appears to be of relatively little value. Of 483 respondents, 92 percent stated they did not buy eggs by brand.

In so far as the consumer is concerned, the unimportance of brands may well be a reflection of the present way that eggs are marketed. To the consumer, ideal brand conditions would be synonymous with ideal grade conditions wherein quality uncertainty is minimized in the purchase of goods. That consumers do not make use of the present branding system is more than likely the result of past experience with variation within brands in addition to the reliance by consumers on sellers as the sole criterion for differentiation.

Suggestions Made by Respondents for Improving the Market

On the basis of subjective responses, qualitative estimates have been made of the degree the utility function has been maximized. It is of interest to observe what consumers would like to see done in the market to increase the satisfaction derived from the consumption of eggs.

Respondents were asked what they would like to see done in the Des Moines market to help them when buying eggs. Suggestions provided by 152 respondents may be found in Table 25.

Thirty percent of 161 respondents buying from producers and 36 percent of 292 respondents buying from stores made suggestions. The minor attention given to price by

respondents may be accounted for either in an unwillingness to indicate the effect of price on purchases of eggs or else in the acceptance of price as a given variable beyond their control. The suggestions on the other factors may prove of value to individual sellers in improving their competitive position, and, ipso facto, the efficiency of marketing eggs in Des Moines.

Table 25. Suggestions by Respondents for Improving the Des Moines Market

Suggestion	Producer		Store	
	No.	Percent	No.	Percent
Quality[1]	43	72.9	88	71.0
Price[2]	5	10.4	14	11.3
Merchandising[3]	4	8.3	15	12.1
Other[4]	4	8.3	7	5.7
Total	56	99.9	124	100.1

[1]Want to know grade, better grading system, candle all eggs, fresher eggs, refrigerate eggs, keep eggs clean, date eggs.

[2]Lower price, reduce margin between producer and grocery store.

[3]Don't seal carton, cellophane top on carton, better display.

[4]Want to know retailer, want to buy by pound and not dozen, want infertile eggs.

Quality Uncertainty in the Market

The suggestions presented in Table 25 implicitly set forth the central theme around which this study has been organized. It will be recalled that most respondents bought eggs on the basis of size because size was the one factor that could be depended upon. Similarly, few respondents considered egg advertisements a reliable source of information because of the uncertainty of the kind of eggs advertised. Rather did respondents associate the reliability of the advertisement with their knowledge of the dependability of the retailer. In Table 25, except for suggestions on price, many of the suggestions continue to indicate a desire to minimize the uncertainty of quality variation in their purchases of eggs.

These continued references to quality variation in the Des Moines market suggest that the value of the utility function could be maximized if uncertainty of quality variation were minimized. The problem of quality uncertainty and its effect on the utility function is the subject of the following discussion.

Two conditions of purchase may face a buyer of eggs in any market:

(1) The buyer is absolutely certain that the good (eggs, for example) purchased will be unsatisfactory; or, the buyer

is absolutely certain that the good purchased will be satisfactory.

In the former case when continued purchases of unsatisfactory eggs are made over time, buyers tend to substitute other foods for eggs whenever possible and the demand for eggs decreases. This is an example of complete certainty that any eggs that are purchased will be of a lower quality than desired. In the latter case, there is complete certainty that the eggs purchased will meet all the quality preferences desired by the buyer. Under this latter condition, a maximum position can be obtained by both buyer and seller and demand maintained or possibly increased.

(2) In between the two extremes of certainty of purchase there is the more common example of quality uncertainty. Under this condition, the buyer occasionally finds that he has purchased a lower quality than expected, and on other occasions finds that he has purchased just what he wants. But at no time is the buyer absolutely certain that what he has purchased is what he desires -- he only hopes that it is.

The condition of quality uncertainty can be discussed under two different situations: ex post and ex ante. In the ex post case, the buyer occasionally finds that he has purchased a lower quality than desired AFTER the purchase

has been made. In the ex ante case, the buyer is influenced by previous purchases but hope BEFORE the purchase to be able to buy the quality he likes the most. Ex ante is therefore based upon ex post experiences, and is a type of subjective, lagged expectation on quality.

The two situations, ex post and ex ante, can be observed under conditions of quality uncertainty.

First, the ex post condition:

In this case the buyer is presented with two different qualities, X and Y, of the same commodity. Since X is a higher quality in the mind of the buyer, X and Y are two different commodities.[1] The marginal rate of substitution between X and "other goods" (the amount of X which will compensate for a loss of the last unit of "other goods") is greater than the marginal rate of substitution between Y and "other goods." In other words, more of Y than of X is needed to substitute for a loss of marginal unit of "other goods."

Now if the buyer purchases what he believes to be X but finds that Y has been purchased, his new position can obviously not be at the maximum. If the buyer consumes Y (rather than go to the bother of exchanging it for X), his position is optimal (i.e., he makes the best of a given

[1] With reference to eggs, X might be considered grade A and Y as grade B.

situation and is located at one of several lower maxima) but can never be at the one maximum point providing the greatest satisfaction.[1] The highest optimum is synonymous with the one maximum point, and can only be reached by purchasing and actually obtaining X. Thus, even if both X and Y are purchased over a period of time, the average of all optima will be lower than if X were consistently expected and purchased.

Ex ante: On the basis of ex post incidents, the buyer becomes skeptical about future purchases of X. (What housewife, upon opening a few rotten eggs, would not be skeptical of future purchases of eggs?) In the long run we would expect unsatisfactory purchases to result in a lowering of demand. Demand is also lowered in the short run but the reaction is not as apparent, the long run decrease being made up of finer incremental short run decreases.

With the purchase of previous Y's in mind, the buyer never quite buys that last marginal unit of expected X. In other words, with quality uncertainty existing, the buyer tends to discount his purchases of the commodity. This may be shown by means of an indifference map of an individual as in Figure 1.

Any one of the indifference curves convex to the origin

[1]The utility function of the individual is maximized at that point.

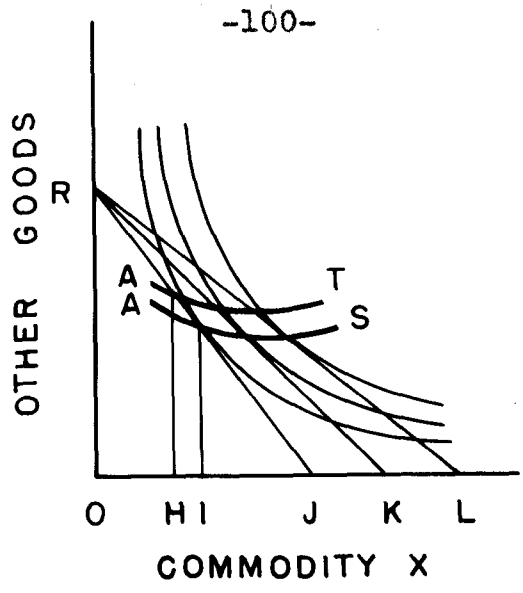

Fig. 1 Conditions of Quality Certainty and Uncertainty.

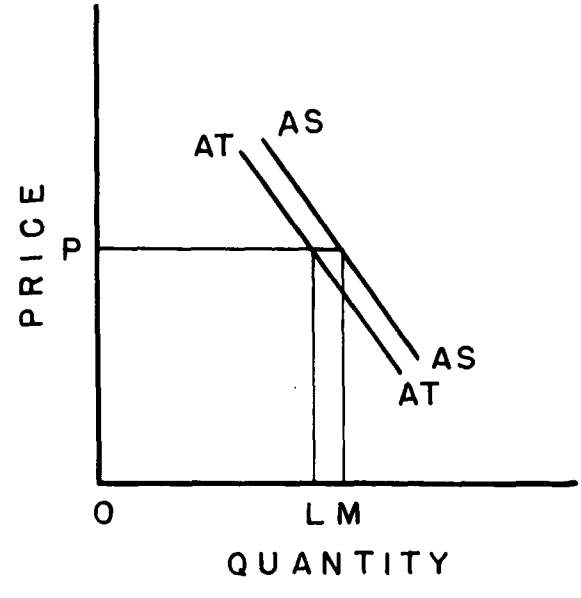

Fig. 2 Demand Functions Under Conditions of Certainty and Uncertainty.

shows the level of satisfaction obtained by the individual under different combinations of "commodity X" and "other goods." The curves are assumed to be monotonically increasing from the origin.

The line, RJ, shows the ratio of the price of "other goods" to the price of "commodity X" since OR is the amount of "other goods" that can be obtained with a given income, and OJ is the amount of "commodity X" that can be obtained with that same income. The individual is at the maximum level of satisfaction when he equates the marginal rate of substitution between "other goods" and "commodity X" with the price ratios.[1]

With quality certainty existing, the price of other goods held constant, AS connects maximum satisfaction points under different prices of X; AT similarly connects optimum positions under uncertainty in the ex ante sense of discounting purchases on the basis of ex post incidents. With reference to the price-consumption line, AT, purchases of X are discounted by the amount HI of X at that income level.

A demand schedule can now be obtained for both price-consumption lines, AT and AS. The familiar Marshallian

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[1]For further references on this discussion, Cf. Reder, M. W. op. cit. pp. 21-23.

demand curve expresses the amount of a commodity that can be obtained by varying the price of that commodity at the same time holding the prices of other goods constant. The demand schedules of Figure 2 are thus directly obtained from the price-consumption curves. The demand schedule, AS, is related to the price-consumption line, AS. The same is true of the demand schedule, AT.

Thus, similar to the positive buyer discount under uncertain price expectations, a negative buyer discount is shown to exist under uncertain quality expectations. At a price, OP, OL of expected X is taken in contrast to OM when absolute certainty of quality of X exists.

Since OM at OP provides the highest satisfaction, ceteris paribus, the purchase of OL at OP (plus the purchase of any other goods with the "extra" purchasing power equal to LM at OP) must provide a lower maximum of satisfaction. Similarly, with reference to the indifference map of Figure 1, the purchase of OH of commodity X must place the individual on a lower indifference level than if OI had been bought. That is, a lower indifference curve must intersect the price ratio line, RJ, and cannot be tangent to it.

Conclusion on Quality Uncertainty

This much can be said for a grading law that requires the contents of an article to be clearly defined to the buyer: by reducing the variation of quality within a grade and by describing the contents of a grade, uncertainty of purchase for the buyer is reduced and a higher level of consumer satisfaction can be obtained since expected quality purchased is that defined. This is in sharp contrast to expected quality purchased being defined on the basis of a hope cultivated by previous purchases.

In the sense that marketing efficiency is defined in this study, it can be concluded that if the contents of a dozen eggs are defined clearly, the market will be more efficient since consumers can then reach a more preferred position.[1] Under a marketing condition of this sort, if consumers are able to choose from one of several qualities, the utility function will be maximized.[2]

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[1]It might be worth while pointing out that this analysis holds only for the Anglo-Saxon culture in which certainty of price and quality is desired by the community. The analysis would not hold for many Mediterranean and Asiatic nations where haggling is the order of the day and satisfaction is apparently derived from its existence. In other words, the analysis cannot be applied to cases where a premium is given for uncertainty.

[2]This conclusion assumes that the cost of such a grading law decreases welfare less if such a program is undertaken than if a grading law is not used.

Conclusions on Marketing Efficiency

Within the limitations of the techniques used in this study, let us now draw a conclusion on what the findings indicate relative to the efficiency with which eggs are marketed in Des Moines.[1]

Firstly, preferences by a majority of the respondents for interior quality did indicate that A (or AA) was preferred over B, over C. Unless sellers were aware of these preferences, (assuming that the only reason they do not respond to consumer preferences is because of lack of knowledge), consumer satisfaction from the consumption of eggs could be maximized only by chance.

What, then, did respondents purchase? The evidence indicates that consumers in Des Moines purchased higher quality eggs much cheaper at the farm than at nearer sources of supply in the city. It appears that in response to this price-quality condition, about 34 percent of the respondents purchased eggs at the farm. And, even for respondents making purchases within Des Moines, selective egg buying at

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[1]Briefly, the limitations are as follows: (1) Sampling and non-sampling errors and biases; (2) lack of knowledge about whether or not consumers will pay enough for their preferences to make it profitable to sellers to respond; (3) problem of using photographs of interior quality to establish interior qualities sold by different sources of supply.

sources other than those nearest the home was evident. Moreover, the questionable value of egg advertisements (except when related to reliable sellers), the dissatisfaction of respondents with egg purchases, and repeated references by respondents to quality uncertainty further substantiated the observation that maximum efficiency in the marketing of eggs did not exist.

What, then, is recommended for increasing the efficiency of marketing eggs in Des Moines? Since marketing efficiency is defined relative to the maximization of the utility function of consumers, it is concluded that efficiency would be increased by clearly defining the contents of a dozen eggs so that the expected quality that is purchased is that quality defined. If buyers have the opportunity of selecting from alternative qualities under this condition, maximum efficiency will exist.

Conclusions on Methods

Much discussion in this dissertation has been devoted to methods and techniques. Many of the non-sampling questions encountered in the sampling procedure could have been minimized by more thorough preparation prior to the field work. But some of the questions arising in the use of survey data for estimating marketing efficiency are not

so easily answered.

If an investigator desires information only on the ordering by consumers of preferred physical factors, the analysis of observations made by respondents on photographs appears to be satisfactory. This technique might be of value in studies in which price is of no consequence. But in analyzing preferences involved in a commodity such as eggs, wherein preferred factors in eggs require added costs to sellers in transportation and handling, price differentials are very much a part of the concept of marketing efficiency. If consumers are not willing to pay more for desired factors so that producers will have the incentive to respond to their preferences, then preferences of consumers have no economic meaning.

It was found that very little could be done, with the data at hand, in analyzing how much consumers would pay for their preferences; it was then assumed that consumers were willing to pay for their preferences but producers did not respond because of imperfect knowledge on their part.[1] The analysis of marketing efficiency thereby pro-

[1] If it had been possible to estimate differentials consumers would pay among qualities, the assumption would then have to be made that sellers would find it profitable to respond. This assumption in an analysis of marketing efficiency would have been less limiting than, as was found necessary, the assumption that consumers would pay for their preferences.

ceeded along a very narrow path in which emphasis was placed entirely on estimating the degree the utility function was maximized.

Attempts at broadening the investigation into how much respondents would pay for their preferences led to the presentation of experimental designs that might be used on the retail level. It would appear that succeeding research on consumer preferences might be concerned with observing the validity of these suggested experimental designs. In a market of the type found in Des Moines, information on how much consumers would pay for desired quality factors would appear to be the kind of information that producers and those contemplating egg grading legislation could use.

SUMMARY AND CONCLUSIONS

Consumer preferences for eggs and their reflection to sellers were investigated in this study as a means to estimating the efficiency with which eggs were marketed in Des Moines. An efficient egg market is defined as one in which consumers, under a given income distribution, obtain the greatest amount of satisfaction possible in the consumption of eggs such that no other method of marketing a given quantity of eggs will provide greater satisfaction. If preferences for eggs are not reflected to sellers, consumer satisfaction can be maximized only by chance since sellers are unaware of desired qualities. It is assumed that sellers can respond to preferences, and that the only reason they do not is because of imperfect knowledge of consumer preferences.

Consumer preferences for different factors were examined. Interior quality preferences were related to established grades by obtaining observations from respondents on four United States standards of quality for individual eggs, AA, A, B, and C. Colored photographs of these grades were pasted on circular disks and randomly numbered. Top view photographs and top-view-with-profile photographs of these grades were used on two different charts. The two

charts gave similar results: There was no significant agreement on AA being preferred over A and vice versa, but AA (or A) was preferred over B and B was preferred over C. The profile chart appeared to aid respondents in their selection.

More general observations were obtained on other preference factors. Respondents were asked about shell cleanliness, shell color preferences and yolk color preferences. Shell cleanliness did not appear to be a problem to respondents although samples of store eggs did indicate a high number of dirty shells when graded according to United States Department of Agriculture standards. About 50 percent preferred a particular shell color; a slightly larger number preferred white than preferred brown shells. Darker yolk colors were preferred to lighter yolk colors.

Although it would have been informative to learn whether or not respondents would pay for their preferences, it was concluded that survey data would not permit such estimates since the supply of varying qualities and different preference factors confounds any estimates of the relation of quality and price. To take the supply factor into account, it was concluded that experimental designs in stores, in which price differentials among qualities are the stimuli, would provide estimates of the monetary value consumers place on preferences. Suggested experimental designs were

presented for studying preferences of one factor or several factors simultaneously.

The remainder of the analysis was involved with estimating marketing efficiency and the extent that the utility function of consumers was maximized. The following observations led to the conclusion that the efficiency of marketing eggs was not at a maximum:

(1) Higher quality and prices which averaged ten cents lower at the farm appeared to be primary reasons that 34 percent of the respondents purchased eggs from producers.

(2) Eggs were not purchased at the nearest sources by respondents because of distrust of retailers, too high prices, and poor quality.

(3) Of respondents buying eggs from retail stores and primary producers, a much higher percent of store purchases were unsatisfactory.

(4) Uncertainty of purchase was repeatedly referred to by respondents.

In view of the condition of quality uncertainty in Des Moines, it was concluded that marketing efficiency could be increased, if not maximized, by introducing a grading law in which the contents of a carton of eggs were defined clearly to buyers. Theoretical reasoning also led to the belief that such a grading law would minimize quality discounting and strengthen if not increase the demand for eggs.

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ACKNOWLEDGMENT

Many have given valuable assistance in the development of this dissertation. In particular, I want to express my gratitude to Dr. G. S. Shepherd, chairman of the dissertation committee, who critically reviewed the manuscript in its several phases; to Dr. R. L. Baker who originated the project and who aided in the early analytical stages; to Dr. R. J. Jessen, D. G. Horvitz and J. Monroe for their aid in drawing the sample and reviewing the sampling section (Dr. Jessen, in particular, stimulated the critical approach in the analysis); to Dr. D. Kaldor for his discussions relevant to the theory; to Dr. M. Liston for her specific observations on early drafts and her suggestions on readings on consumer economics; to Drs. G. Tintner, J. Nordin and E. Jebe for their aid on statistical questions (Dr. Jebe's comments on the manuscript are worthy of special mention); and to Earl Kehrberg who was of aid in the last stages. Other associates helped on particular points.

APPENDICES

APPENDIX A

CHARTS USED FOR DETERMINING INTERIOR QUALITY PREFERENCES

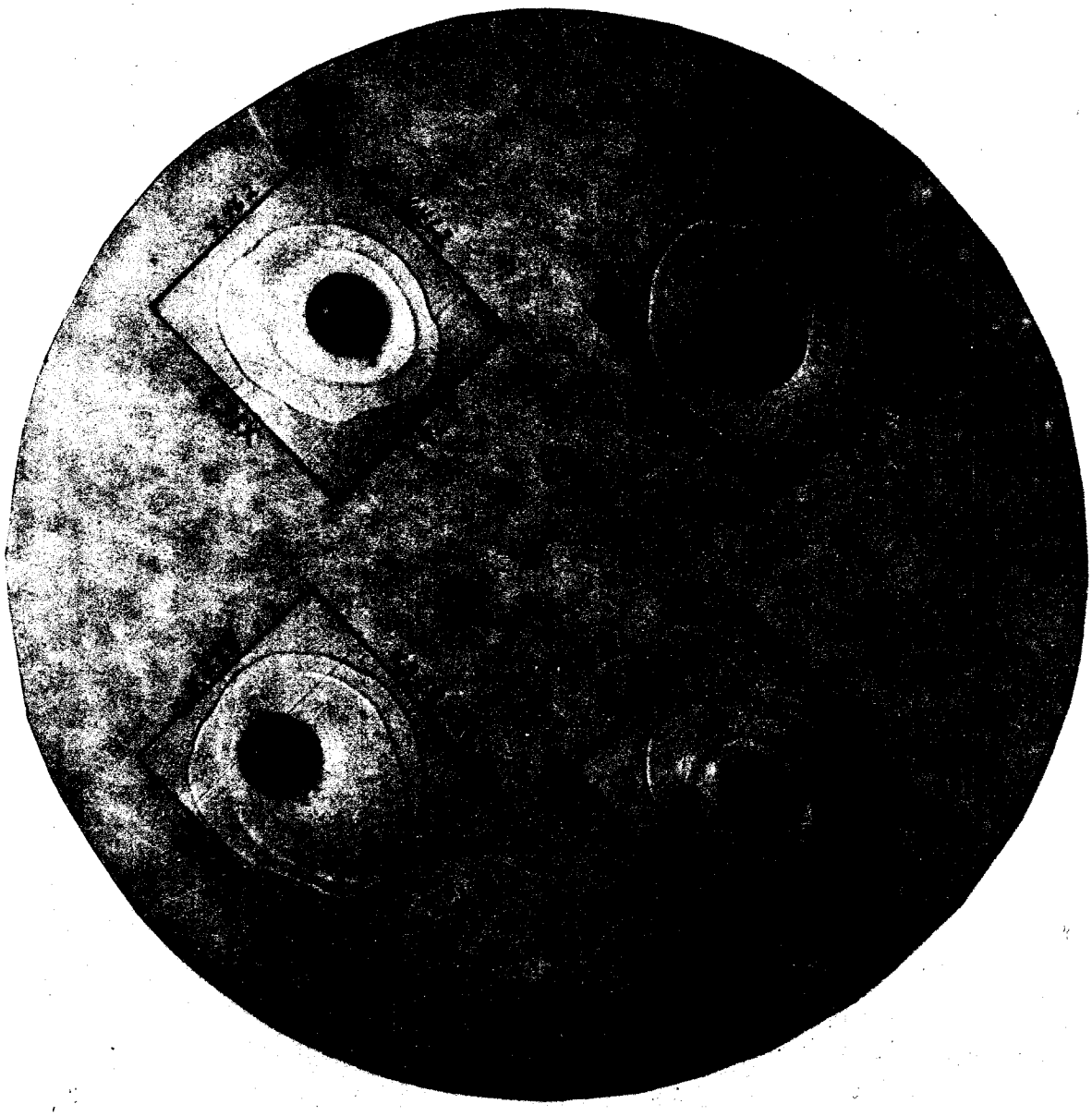

Fig. 3 Top View Photographs of Four Grades.

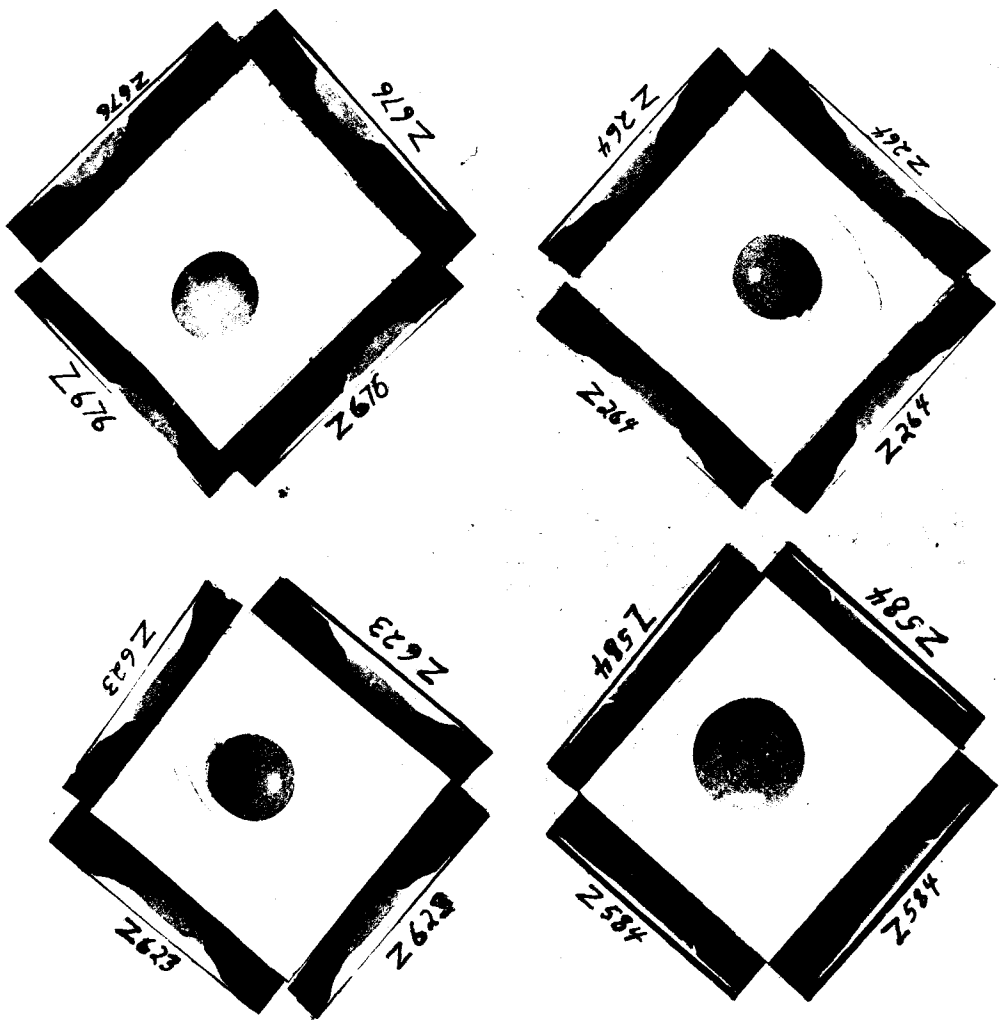

Fig. 4 Top View with Profile Photographs of Four Grades.

APPENDIX B

RANK CORRELATION OF PREFERENCES

The preferences of each respondent were numbered from 1 to 4, 1 being the most preferred; the following was obtained:

	471	AA	A	B	C
Sum of Columns - Σ		1128	990	1176	1416
Deviations from Mean -		-49.50	-187.50	-1.50	+238.50

$$\bar{x} = \frac{4710}{4} = 1177.50$$

Since

$$W = \frac{12\ S}{m^2(n^3-n)}$$

Where:
W = coefficient of concordance
S = sums of squares of deviations from the mean
m = the number of rankings
n = the number of grades

Thus

$$W = \frac{12(94491)}{(471)^2(4^3-4)} = \frac{1,133,892}{13,310,460}$$

$$W = .085188$$

It will be noted that "m" in this case is 471 rather than 503. The difference, 32, resulted from discarding 7 ties in which respondents could distinguish no difference between or among some or all of the grades, and 25 respondents who were not asked, gave no answer, or did not know how to answer.

The test of significance for "W" involved the use of Fisher's "z" distribution. The z for the obtained W was computed from:

$$z = \frac{1}{2} \log_e \frac{(m-1)W}{1-W}$$

The degrees of freedom were computed from the formulae:

$$V_1 = n-1 - \frac{2}{m}$$

$$V_2 = (m-1)\ V_1$$

By computation:

$$z = 1.88868 \text{ for } V_1 = 2.996$$

$$V_2 = 1408$$

The z obtained is significant on the 5 percent level. Thus, while the coefficient of concordance is low (which would appear to imply little agreement between respondents as to grades), the coefficient is significant and agreement on the differences between grades is not rejected on the 95 percent level of probability.

However, the low coefficient would also imply some disagreement on ranking somewhere in the four grades. For this reason, the rank correlation method was used for noting agreement or lack of agreement between only two grades in contrast to the four grades previously ranked together. The following pairs were recorded and tested:[1]

[1] Recoding requires that values for all four grades, i.e., 1, 2, 3, 4 must be revalued for grades compared. For example, when comparing A with B, in a case where we have 4, 3, 2, 1 for rankings, B is preferred over A and is revalued at 1 instead of 3; similarly, A is revalued at 2 instead of 4 and thus, the recoded values are 2 and 1 rather than 4 and 3.

Grades AA versus A:

Grades	
AA	A
column sums	

$\bar{x} = 706.5$
$S = 840.5$
$W = .0075775$ (insignificant)

Grades A versus B:

Grades	
A	B
column sums 635	778

$\bar{x} = 706.5$
$S = 10224.5$
$W = .092179^{**}$[1]

Grades A versus C:

Grades	
A	C
column sums 611	802

$\bar{x} = 706.5$
$S = 18240.5$
$W = .164450^{*}$[2]

Grades B versus C:

Grades	
B	C
column sums 608	805

$\bar{x} = 706.5$
$S = 19404.5$
$W = .17494^{**}$

It is to be noted that no significant difference on the 5 percent level was found between grades AA and A -- i.e., no significant common agreement on the ranking of the two grades. Of the seven ties not used in the rank correlation, all seven involved ties between AA and A. The differences (or common agreement on ranking) between grades A and B, A and C, and B and C, are significant at the 1 percent level indicating common agreement on the preference of A over B and B over C.

---

[1] **significant on the .01 level of significance.

[2] *significant on the .05 level of significance.

Rank correlation of preferences of subsample

First, the rankings of the top view chart:

Grades AA versus A versus B versus C:

	Grades			
	AA	A	B	C
column sums	120	116	145	169

$\bar{x}$ = 137.5
m = 55 (5 ties and 3 responses providing no information were discarded)
S = 1817
W = .12013**

Grades AA versus A:

	Grades	
	AA	A
column sums	82	83

$\bar{x}$ = 82.5
S = .50
W = .00066942 (insignificant)

Grades A versus B:

	Grades	
	A	B
column sums	72	93

$\bar{x}$ = 82.5
S = 220.5
W = .14579**

Grades B versus C:

	Grades	
	B	C
column sums	72	93

W = .14579**

Grades A versus C:

	Grades	
	A	C
column sums	71	94

$\bar{x}$ = 82.5
S = 264.5
W = .174876**

Next, the rankings of the profile chart:

Grades AA versus A versus B versus C:

	Grades			
	AA	A	B	C
column sums	109	112	150	199

$\bar{x}$ = 142.5
n = 57 (4 ties and 2 "no information" responses)
S = 5301
W = .326316**

Grades AA versus A:

	Grades	
	AA	A
column sums	83	88

$\bar{x}$ = 85.5
S = 12.50
W = .00769468 (insignificant)

Grades A versus B:

	Grades	
	A	B
column sums	72	99

$\bar{x}$ = 85.5
S = 364.5
W = .224377**

Grades B versus C:

	Grades	
	B	C
column sums	66	105

$\bar{x}$ = 85.5
S = 760.5
W = .468144**

Grades A versus C:

	Grades	
	A	C
column sums	66	105

W = .468144**

APPENDIX C

INTERIOR QUALITY SELECTIONS AND REASONS FOR SELECTION

The following is presented to further substantiate the observation that the selection of eggs from the photographs and reasons for selection were not always consistent. More consistency of response is to be observed in the selection of the "better" grades.

Egg picked as best	Reasons for picking first choice eggs	Number	Percent
AA	Upstanding yolk, white thick and firm - not spread out	172	91.5
	Yolk centered	3	1.6
	Miscellaneous reasons	3	1.6
	Just like it, don't know, irrelevant answer	10	5.3
		188	100.0
A	Upstanding yolk, white thick and firm - not spread out	76	85.4
	Upstanding yolk, white thick and firm, not spread out and well-centered	2	2.3
	Yolk centered	1	1.1
	Larger yolk	2	2.3
	Miscellaneous	2	2.2
	Just like it, don't know, irrelevant answer	6	6.7
		89	100.0
B	Upstanding yolk, white thick and firm, not spread out	8	40.0
	Larger yolk	1	5.0
	Smaller yolk	1	5.0
	Thin white, spreads out evenly, no second layer	3	15.0
	Miscellaneous	3	15.0
	Just like it, don't know, irrelevant answer	4	20.0
		20	100.0

Reasons for Picking Best Egg - Regardless of Choice

	Number	Percent
Upstanding yolk, white thick and firm, not spread	284	56.5
Larger yolk	54	10.7
Thin white, spreads out evenly, no second layer of white	38	7.6
Yolk centered	8	1.6
No chalazae (or white stuff along side of yolk)	7	1.4
Combinations of relevant answers	13	2.6
Miscellaneous answers	21	4.2
Just like it, don't know, irrelevant answers	56	11.1
Made no selections (wouldn't rank, don't use eggs, etc.)	22	4.4
	503	100.1

Egg picked as poorest	Reasons for picking last choice eggs	No.	Percent	Percent picked as poorest
C	Yolk flat, white thin and spread out, watery	223	90.7	
	Large yolk	2	.8	
	Miscellaneous answers	8	3.2	
	Just don't like it, don't know, irrelevant answers	13	5.3	
		246	100.0	48.9
B	Yolk flat, white thin and spread out	43	50.6	
	White thick, firm not spread out, yolk stands up, etc.	8	9.4	
	Small yolk	7	8.2	
	Small yolk, thick white, second layer white, etc.	3	3.5	
	Hard to cook	1	1.2	
	Yolk not centered	2	2.4	
	Miscellaneous and other combinations	7	8.2	
	Just don't like it, don't know, irrelevant answers	14	16.5	
		85	100.0	16.9

Egg picked as poorest	Reasons for picking last choice eggs	No.	Percent	Percent picked as poorest
A	Small yolk	10	24.4	
	White thick, firm, not spread out, second layer white	9	22.0	
	Chalazae or white stuff at edge of yolk	4	9.7	
	Yolk flat, white thin and spread out, watery	3	7.3	
	Miscellaneous and combinations	2	4.9	
	Just don't like it, don't know, irrelevant answers	13	31.7	
		41	100.0	8.2
AA	White thick, firm, not spread out, second layer of white	27	26.7	
	Small yolk	14	13.9	
	Yolk flat, white thin and spread out, watery	12	11.9	
	Chalazae or white stuff at edge of yolk	3	2.9	
	Yolk not centered	2	2.0	
	Miscellaneous and combinations	9	8.9	
	Just don't like it, don't know, irrelevant answers	34	33.7	
		101	100.0	20.1
	Number not making rank selection - 30			6.0
				100.0

APPENDIX D

A POSSIBLE REASON FOR HIGHER CREAM SHELL COLOR PRICES

Price-shell color relationships of the sample of 47 stores is presented in an attempt to check on the significantly higher average price for cream colored shells shown in Table 14.

Table 26 presents prices and shell colors observed in the sample of 47 stores.

Table 26. Prices in Retail Stores for Different Colors

Color found	Number	Percent	Mean price
Mixed colors	20	42.6	64.9
Brown	13	27.7	63.2
White	5	10.6	61.8
Cream	9	19.2	66.2
Total	47	100.1	

Here again, no premium price pattern can be established for different colors except for creams that persist in being much higher.

To compare the store prices of Table 26 with the prices quoted by respondents buying store eggs in the major household sample, schedules from 161 respondents buying eggs from producers were not used. The results are shown in Table 27.

Even when producer prices are not included, the previous observations on color preferences are unaltered --

i.e., creams persisting at a higher price, but no significant differences appearing among other shell color prices. Nor is any price difference noted for those with a color preference and those without a color preference.

Table 27. Prices of Respondents Buying at Stores[1]

Those having	Number	Percent	Mean price
No color preference	163	47.5	55.8
A color preference	179	52.5	57.2
For white	93	52.0	55.9
For brown	80	44.7	55.8
For cream	6	3.4	60.0
Total	342	100.0 100.1	56.9

[1]In the period of one month, as reported by the Federal-State Market News Service, the wholesale price of grade A eggs rose 5 cents. For this reason, the prices reported by respondents buying at stores are about 5 cents lower than prices of eggs noted at stores in the store sample. In the field work in the major sample, an attempt was made at enumerating in different areas of the city to prevent bias resulting from collecting observations in one limited area at any one time.

Persistence of Higher Prices for Cream Colored Shells

The above cross tabular analyses do point to the price for cream colored shells being persistently higher than the prices for other shell colors. The number stating a preference for cream colored shells is too small to permit any statement on the monetary value of preferences for this color, but the tendency for higher cream prices is

well worth while investigating.

In the retail study, it was observed that food prices were generally high in high income areas (or low in low income areas). It is reasonable, therefore, to attempt to explain the higher prices for cream colored shells by location theory.[1]

Purely from observation in the city as well as from incomes quoted in the study, the higher income area in Des Moines appeared to start around 28th Street continuing to the west. Using this as a guide, the prices and colors of all eggs for those stores found between 28th Street and the western city limits were tabulated. Twelve of the 47 stores were found in this area. The average price for these stores was 67 cents per dozen compared to an average price of 63 cents for the 35 other stores in the study. This result is similar to the price pattern presented in Table 30 for different shell colors.

Of the 47 stores in the sample, 20 sold mixed colors, 12 sold browns, 5 sold whites, and 10 sold creams. Fifty percent of the creams were found to be sold by the higher income area stores. Obviously, considering the arbitrary

[1]Black, G. discussed this question. op. cit. pp. 52-56. Black concludes that aside from the tendency of high income groups to buy different and more expensive foods than the lower income groups, prices tend to rise with the level of income since higher income groups pay for additional marketing services rendered by the more expensive stores.

division of income areas and the small number of stores in the sample, little more can be said other than to imply that the high prices found for creams may be more the result of location than of a willingness to pay more for shell color preferences.

APPENDIX E

SUGGESTED EXPERIMENTS FOR OBSERVING MONETARY VALUE CONSUMERS PLACE ON THEIR PREFERENCES

Partial Preference Experiment

At the outset, it may be of aid to see the over-all picture of the experiment. Firstly, stores will be selected (within a market or in several markets) with particular reference to those which cater to a clientele representative of all socio-economic groups. Large supermarkets in general shopping areas appear suitable for this requirement. Within each selected store, treatments -- i.e., price differentials for variations of the factor to be examined -- will be applied on each day of the week. No treatment will be applied more than once on each day in each store within the period of a week. It may be that treatments will be applied on a weekly basis rather than daily.

Within each selected store, customers will be informed about the exact content of each carton of eggs. All variables other than the factor studied will be held constant. In this manner, cause and effect (by "effect" is meant quantity disappearance) can be uniquely established.

Latin square design

Model (5) is repeated once again:

$$y_{ijk} = u + l_i + d_j + t_k + e_{ijk} \qquad (5)$$

Where:

y_{ijk} = quantity disappearance of relevant factor variations

u = over-all mean effect

l_i = location effect (ith location)

d_j = day effect (jth day)

t_k = treatment effect (kth treatment) where treatments are selected

e = experimental (residual error)

The latin square design proposed relative to model (5) is given in Table 28.

The analysis of Table 28 is presented in Table 29. A breakdown is possible for comparing specific treatments -- e.g., a control against any of the three other treatments.

Analysis of Several Preference Factors Simultaneously

The purchase of eggs is influenced by several variables within the commodity itself. This is shown symbollically in (6):

$$y = f(Px, C, S. Q, K, L) \qquad (6)$$

Table 28. Latin Square Proposed

	Day or week	Store 1 Qualities a	b	c	Store 2 Qualities a	b	c	Store 3 Qualities a	b	c	Store 4 Qualities a	b	c	Row total
		Treatment A			Treatment B			Treatment C			Treatment D			
	t_o	--	--	--	--	--	--	--	--	--	--	--	--	
I	t_1	--	--	--	--	--	--	--	--	--	--	--	--	
	Total	--	--	--	--	--	--	--	--	--	--	--	--	
	Cell total			---			---			---			---	---
		Treatment C			Treatment D			Treatment B			Treatment A			
	t_o	--	--	--	--	--	--	--	--	--	--	--	--	
II	t_1	--	--	--	--	--	--	--	--	--	--	--	--	
	Total	--	--	--	--	--	--	--	--	--	--	--	--	
	Cell total			---			---			---			---	---
		Treatment B			Treatment A			Treatment D			Treatment C			
	t_o	--	--	--	--	--	--	--	--	--	--	--	--	
III	t_1	--	--	--	--	--	--	--	--	--	--	--	--	
	Total	--	--	--	--	--	--	--	--	--	--	--	--	
	Cell total			---			---			---			---	---
		Treatment D			Treatment C			Treatment A			Treatment B			
	t_o	--	--	--	--	--	--	--	--	--	--	--	--	
IV	t_1	--	--	--	--	--	--	--	--	--	--	--	--	
	Total	--	--	--	--	--	--	--	--	--	--	--	--	
	Cell total			---			---			---			---	---
	Totals	--	--	--	--	--	--	--	--	--	--	--	--	---
Column totals				---			---			---			---	---

Where: Treatment A, B, C, D are price differentials for the qualities.
Qualities a, b, c refer to interior qualities or variations of other preference factors.
t_o, t_1 refer to time periods (only one time period may be necessary but two are possible).
I, II, III, IV refer to different days of the week or different weeks.

Table 29. Analysis of Variance[1]

SV	d.f.	E.M.S.
Rows	3	
Columns	3	
Treatments	3	
Experimental error	6	$6\sigma_c^2+2\sigma_e^2+6\sigma_e^2$
Among qualities in cells	32	$6\sigma_c^2+2\sigma_e^2$
Among qualities in columns	8	
Remainder	24	
Between readings on the same quality	48	σ_c^2
Total	95	

[1]A covariance adjustment for price differential treatments is unnecessary since it is the relative disappearance of the qualities that is important, and this is unaffected by such factors as numbers of customers varying among stores. Similarly there is no need to adjust for lagged effects of following treatments since buyer knowledge will be perfected in each treatment.

Where:

y = purchase of eggs.

Px = price -- in this problem absolute differentials are used among qualities. Four differentials will be examined: 2¢, 5¢, 10¢, 15¢.[1]

C = shell color, white, brown, cream, mixed.

S = size -- small, medium, large.

Q = interior quality -- grades A, B, C, according to either the USDA recommendations or those preferences established by experiments in stores.

K = carton -- will be kept constant in this analysis although it may be of interest and is possible for analysis. It is kept constant in view of the large number of treatments in the study.

L = cleanliness - also will be kept constant for the same reason presented under K.

It is the effect of all the above variables on purchases that is of importance. Any experiment that analyzes the effect of one variable on sales (as in the previous experiment) and assumes the effect of other factors constant, must face the possibility of assuming away a major problem.

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[1] As would be true of the partial preference study, the differentials would have to be examined not only within one time period but between two time periods, say, in which the price indices for eggs were widely dissimilar.

Composition of treatments

There is a certain amount of immobility on the part of a consumer when shopping in a store. That is, although a good many not be entirely satisfactory, rather than go a few doors or miles to purchase the exact good desired, the consumer weighs the inconvenience of additional shopping with the convenience of the immediate purchase and makes a decision. If there is no certainty that additional shopping will provide the good desired, the consumer is apt to accept the immediate purchase. Acceptance of an immediate purchase is usually proportionate to the income effect of alternative action -- a more expensive good calling forth more "rational" thought and decision. With a commodity such as eggs, the income effect is small and a decision on alternative action (i.e., shopping in another store for more desired eggs) is relatively minor. The inconvenience of shopping for more desirable eggs is large when the psychology of the consumer is to buy all goods in one store.

Under these circumstances, therefore, consumers must be provided with more than one variation of the good, eggs. At the same time, however, the numbers of alternative choices provided cannot be so great as to confuse the buyer and cause purchases to be irrational. At least more than one alternative purchase must be available, therefore, but

not so many alternatives as to confuse the individual buyer. In view of the variation of the factors involved, it is suggested that pairs of observations for the same factor are most desirable from the point of view of applying treatments on an individual store level.

Possible combinations of pairs of variables

Interior quality - A, B, C, quality - $3\ {}_3C_2 = 3$ prs.

Size - small, medium, large - $3\ {}_3C_2 = 3$ prs.

Alternative: May possibly have only two sizes, small and large, in which case there would be only 1 pair.

Color - white, brown, cream, mixed - $4\ {}_4C_2 = 6$ prs.
Alternative: If no cream is used, then have only 3 pairs. If only white and brown are used, then 1 pair.

Price - 4 differentials of 2, 5, 10, and 15 cents = 4 treatments.

Alternative: If drop off 15 cent differential then there are 3 treatments. One differential is applied per store experiment on each day (or week).

The maximum number of treatment pairs is 216. The minimum number arbitrarily decided upon for providing meaningful comparisons is 18.

Symbols for paired combinations

To save space and to simplify the notation, symbols are presented prior to presenting the total number of combinations.

Interior quality -	AB, AC, BC, (1),(2),(3)	(letters stand for USDA interior qualities)
Color -	WB, CB, WC, MW, MB, MC (4),(5),(6),(7),(8),(9)	W = white, B = brown C = cream, M = mixed
Size -	SM, SL, ML (a),(b),(c)	S = small, M = medium L = large
Price -	2, 5, 10, 15 cent differentials (d),(e),(f),(g)	

Single integers or small letter correspond to paired quality factors immediately above.

The paired combinations of quality factors are presented in Tables 30 to 34.

Table 30. Color and Quality Combinations

COLOR	INTERIOR QUALITY		
	1	2	3
4	41	42	43
5	51	52	53
6	61	62	63
7	71	72	73
8	81	82	83
9	91	92	93

Code "41" of the above interior quality and color combinations states the following combinations.

Table 31. Example of Code "41"

QUALITY	COLOR	
	White	Brown
A	A White	A Brown
B	B White	B Brown

Table 32. Quality, Size and Color Combinations

SIZE	QUALITY COLOR PAIRS																	
	41	42	43	51	52	53	61	62	63	71	72	73	81	82	83	91	92	93
a																		
b																		
c																		

(In which there are 18 x 3 = 54 treatment pairs)

The contents of the cells in Table 32 may be obtained by "multiplying" the rows and columns.

Table 33. Price-Quality-Color-Size Combinations (total number possible)

Quality-color-size	Price				Quality-color-size	Price			
	d	e	f	g		d	e	f	g
41a					71b				
42a					72b				
43a					73b				
51a					81b				
52a					82b				
53a					83b				
61a					91b				
62a					92b				
63a					93b				
71a					41c				
72a					42c				
73a					43c				
81a					51c				
82a					52c				
83a					53c				
91a					61c				
92a					62c				
93a					63c				
41b					71c				
42b					72c				
43b					73c				
51b					81c				
52b					82c				
53b					83c				
61b					91c				
62b					92c				
63b					93c				

As with the above combinations of quality, size and color, the contents of the cells in Table 34 may be obtained by "multiplying" rows and columns.

Table 34. Number of Possible Paired Treatment Combinations for Price-Quality-Color-Size (Above)

Factor	Factor Variation Omitted (ceteris paribus)[1]	Number of treatments
Color	Cream	108
	Mixed	108
	Cream + mixed	36
Price	15 cent differential	162
	15 cent differential + cream	81
	15 cent differential + mixed	81
	15 cent differential + creams + mixed	27
Size	Small	144
Size + price	Small + 15 cent differential	108
Size + price + color	Small + 15 cent differential + cream	54
	Small + 15 cent differential + mixed	54
	Small + 15 cent differential + creams + mixed	18

[1]Interior quality--A, B, C--kept constant in all treatments. The maximum number possible under the total number of variables considered is 216.

Cochran and Cox present incomplete designs and their analysis for the following possible number of treatments:[1]

27 treatments: plan 10.0, page 301

36 treatments: plan 10.7, page 309

81 treatments: plan 10.6, page 307

plan 12.6, page 363

144 treatments: plan 10.9, page 310

With reference to 27 treatments, the following design is presented:

Table 35. Incomplete Design for 27 Treatments

Days	Stores								
	1	2	3	4	5	6	7	8	9
Mon.									
Tues.									
Wed.									

This design would be used under the assumption that the days, (Monday, Tuesday, and Wednesday), are similar -- i.e., customers are the "same" on these days, and no "day effect" exists. Treatments would then be applied as shown in Cochran and Cox.

In each replication, "days" would consist of a Monday to Wednesday or a Thursday to Saturday grouping. Replicates

[1]Cochran, W. G. and Cox, G. M. Experimental designs. Second printing. John Wiley. 1950.

would contain those "day" groupings. It might be well to combine only similar day groupings and analyze treatment effects therein. Afterwards, the different day groupings for different weeks could be combined. Of course, when groupings for weeks are all combined for analysis, it is assumed that there is no week effect.

For example, Monday to Wednesday groupings for succeeding weeks could be combined and analyzed separately from Thursday to Saturday groupings. The Monday to Wednesday and the Thursday to Saturday groupings would then be combined and analyzed. The experimental error resulting from the combination of the two distinct groupings in the latter case is likely to be overestimated. However, it would be well to compare the results of the combined grouping with the individual groupings.

An alternative is possible. The alternative is only a slight alteration of the above. Instead of having nine stores, and taking account of a store effect but assuming no day effect, it seems logical to do the reverse: that is, to assume no store effect and account for the day effect. This could be done by replacing the nine stores with nine successive periods (i.e., days and divisions of days). The three days of the week would be replaced by three "identical" stores. This latter approach is more appealing in view of the control that is possible in selecting stores.

Similar manipulation of designs for larger numbers of treatments is also possible. The case of 36 treatments is possibly more encouraging than the others since a 6 x 6 triple lattice (plan 10.7 in Cochran and Cox) would permit the use of 6 days, Monday through Saturday, although 6 stores would be required. The selection of the design obviously will be limited not only by funds but availability of desired types of stores.

APPENDIX F

RESPONSE BIAS ON INTERIOR QUALITY

To observe interior quality sold by a source, respondents were asked to identify one of the interior qualities displayed on the preference chart with the eggs last purchased. While the survey was being taken, it was felt that respondents usually stated that the eggs last bought were similar to the egg ranked as best on the chart. The questions asked respondents were of this chronological order:

(1) Please rank the eggs on this chart in the order of preference.

(2) Which egg on the chart looks most like the eggs you last bought?

Table 36 shows the relationship between the egg selected as best and the eggs respondents said they last used.

Table 36. Egg Ranked First by Those Last Using AA

Which egg looks like ones last used?	Egg ranked first							
	AA		A		B		C	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
AA	107	63.8	4	5.5	--	--	5	3.2
A	39	23.2	55	75.2	2	13.3	16	10.3
B	9	5.3	6	8.2	11	73.3	8	5.2
C	13	7.7	8	11.0	2	13.3	126	81.3
	168	100.0	73	99.9	15	99.9	155	100.0

While respondents may well have bought the eggs denoted as best, it would appear that responses to the second question were influenced by the first question. Responses to the second question assumed that the respondent was capable

of doing two things: firstly, it was assumed that rankings of preferences were ignored and that the respondent could answer, independently of his preferences, what had been bought and not what he would like to buy. Secondly, it was assumed that the respondent could remember what the eggs last bought looked like when they were broken out of the shell.

With regard to independence of response, note that 64 percent of those who ranked AA as best claimed they last used AA; 75 percent ranking grade A as best last used grade A; 73 percent ranking grade B as best last used grade B; 81 percent ranking grade C as best last used grade C. The question may be raised whether or not respondents tended to answer that they purchased only the best and did not or could not actually tell what the eggs last bought looked like. It also is suggested that respondents may not actually have selected the egg purchased but rather the eggs they would have liked to have purchased by virtue of the order in which the questions were asked.

However, regardless of the question of dependence of response, the analysis for determining interior quality may still be used. Even if all respondents said they received only the egg selected as "best," their selection could still be used for determining interior quality at a

particular source since the selection of the best egg is assumed to be influenced by previous purchases. This is the only explanation for the differences in interior qualities found for the two main sources of supply. Similar reasoning holds for the inability of respondents to relate the eggs last used with the photographs of interior qualities. As long as it is reasonable to assume that responses on the interior quality last used are influenced by previous purchases from the source of supply, the technique of having respondents identify eggs last bought with photographs is a reasonable approach.

As long as there is a question, however, on the logic of the technique for relating interior quality to a source, it might warrant investigating other possible techniques. Two other methods are available that are more suitable for obtaining information on egg quality in household surveys than the use of photographs:

1. The enumerator can carry a small candling unit with him to candle eggs that have been purchased.
2. The enumerator can gain permission to break open eggs that have been purchased. These eggs could be replaced by eggs the enumerator would carry with him.

In these two methods, two sources of error exist: (1) If more than one enumerator is used, there will be variation

in quality estimates due to enumerators; (2) interior quality may change under different conditions of keeping eggs at households. Both sources of error may be sufficiently serious to warrant the consideration of methods other than household surveys for obtaining this information.

APPENDIX G

SCHEDULE USED IN THE MAJOR SURVEY

Schedule I
Iowa State College

CONFIDENTIAL

Census Tract _____ Stratum No. _____ Block No. ____ Cluster No. ____ _____

Color _____ Schedule No. ____ Interviewer _____ _____

Date _____ Time of interview ____ to _____

Name _____ Address _____

Interviewee _____ _____

The following questions are divided into five parts. The first part is concerned with your family and your egg eating habits.

1. How many eggs did you use yesterday? _____ _____

   b) How many did you use last week? _____ _____

   c) How many did you use two weeks ago? _____ _____

2. Did you serve eggs for breakfast this morning? _____ _____

   b) Did you serve meat of any kind? _____ If so, what kind? _____ _____

   c) If you did not serve eggs, what was the main breakfast dish this morning?

   _____ _____

3. How many times during the last week were eggs served for breakfast _____ lunch _____ supper? _____ _____

4. How many meals did you serve to guests last week? _____
   two weeks ago? _____ _____

_____

5. Now in order to present our findings on this survey according to size and age distribution, of the family, kind of work, and the like, I'd like to ask a few specific questions about the household.

a) How many people are now living in the household? _____ _____

b) Get relationship to housewife, age, sex, education, and occupation of members of the household.

1	2	3	4	5	6	7	8
Relation to Housewife	Sex	Age	Education	Occupation	No. Meals Eaten Away from Home. (last week)	Anyone on Special Egg Diet? Why?	Anyone Doesn't Eat Eggs? Why?
1. housewife							
2.							
3.							
4.							
5.							
6.							
7.							
8.							
9.							
10.							
Are there any boarders living here? (in the household)							
11.							
12.							
13.							
14.							

5b1 _____ 5b8a _____

5b4 _____ 5b8b _____

5b5 _____

5b6 _____

5b7a _____

5b7b _____

The next set of questions deal with your method of shopping for eggs what you look for, what you saw, where you buy eggs--that sort of thing.

6. How many eggs did you buy last week? (dozen)_____ _____

7. Did you buy all the eggs for the week at one time?_____ _____

8. Where do you keep your eggs? _____ _____

9. Where did you last see eggs advertised? _____ _____

   b) Do you make a practice of watching for egg ads?_____ _____

   c) Can you tell the best place to buy eggs just by looking at the ads?_____ _____

   d) If answer is "yes" to question 11c, ask . . . How can you tell? _____ _____

   e) If answer is "no" to question 11c, ask . . . Why can't you tell? _____ _____

   f) Do you buy a particular brand of eggs? _____ _____

   If so, what brand? _____ _____

10. Do you yourself go to the store to buy eggs? ___Order by phone? _____

    _____ Send the children? _____ Other? _____

11. What's the first thing you look for when you buy eggs? _____ _____

    b) What are some other things you consider important?_____ _____

    _____

12. Are there any shell colors you prefer?__ White ____ Brown _____ _____

    Cream _____

    b) Do you pay more for a particular shell color? _____ _____

    c) Any colors you dislike and wouldn't buy? _____ _____

13. (Enumerator: Don't Read These Choices.) In the eggs last bought, did you have any objections to the outer appearance of any eggs?

_____ _____

b) What was wrong with them? Cracked?_____ Misshapen? _____ _____

Dirty? _____Rough shell _____ Other _____

14. Were the last eggs you bought: Clean? ___Slightly dirty?____ _____

Dirty? _____

15. Do you ever have difficulty buying the quality of eggs you want?

_____ _____

b) Does the time of year make any difference? _____ _____

16. Have you every asked the storekeeper (or whoever sold the eggs) to weigh the eggs before you bought them? _____ _____

b) Would you rather buy eggs by the dozen or by the pound?

_____ _____

17. At the last place you bought eggs, how many different prices did the retailer have for eggs? _____ _____

b) What were the differences? (give grades, prices description) _____

_____ _____

_____ _____

_____ _____

c) Which did you buy? _____ _____

18. Where do you generally buy your eggs? Name_____ _____

Location _____

b) Were the eggs delivered to your door?_____ _____

19. From what other sources have you purchased eggs in the last month?

Name _____ Location _____ _____

Name _____ Location_____

Name _____ Location _____

b) In the last three months? Name _____ _____

Location _____

20. Where did you last buy eggs? Name _____ _____

Location _____

b) Were the eggs kept under refrigeration or on the counter?

_____ _____

c) Were eggs in a sack _____ 3 x 4 carton ____ 2 x 6 carton ___ _____

d) Are most of your groceries bought at this same place? _____

_____

21. Are there any stores that sell eggs between your home and where you usually buy eggs? _____ if so, why don't you buy eggs at _____ these stores? _____ _____

22. In the last month, where did you get the best eggs? Name _____

Location _____

23. What do you suggest would help you in buying eggs? _____ _____

_____

The next few questions deal with the price and quality of eggs. Some of the questions are slightly complicated, and will require some thought before you answer them.

24. What date did you last buy eggs? _____ _____

b) How much did you pay for them? _____ _____

Well, how many would you have bought if the price had been (ENUMERATOR! ADD THE FOLLOWING AMOUNTS TO THE PRICE THAT WAS LAST PAID.) price + 2¢ __doz __; price + 5¢ __doz__; _____

price + 10¢ __doz __; price + 15¢ __doz ____ _____

25. If you buy fewer eggs, how do you change your methods of using them? _____ _____

_____

26. How many eggs would you have bought--using the price you last paid for eggs--if the price had been (ENUMERATOR! SUBTRACT THE FOLLOWING AMOUNTS FROM THE PRICE LAST PAID FOR EGGS.)

price - 2¢ __doz __; price - 5¢ __doz __; price - 10¢ __ _____

doz __; price - 15¢ ___doz ___. _____

27. If you buy more eggs how do you change your methods of using them? _____ _____

_____

28. If you eat fewer eggs, what other foods do you eat in their place? _____ _____

_____ (b) Why? _____ _____

29. If you eat more eggs, what other foods do you eat less of? ___ _____

_____ (b) Why? _____ _____

30. (ENUMERATOR! CUT THE PRICE IN HALF AND QUOTE IT FOR THIS QUESTION.) Would you buy fresh eggs which had cracked shells for one-half the price that you are now paying for eggs?

_____ _____

The following questions are concerned with what you have found out about interior egg quality, and the appearance of eggs on the outside--what you want and what you are receiving for your money.

31. Did you buy any eggs last month that you would have preferred not to use? _____ _____

b) What was wrong with them? (ENUMERATOR! DO NOT READ THESE.) Taste _____ _____

Smell _____ Yolk Color _____ Blood Clot ___ Germ Development _____ Mottled Yolk ___ Cloudy White ___ Dirty Shell ___

Watery ____ Flat Yolk _____ Other _____

c) Where did you purchase these eggs? _____ _____

d) Do you continue to buy from the same place? _____ _____

32. Do you bake most of your own cakes? _____ _____

b) Do you use prepared cake mixtures? _____ _____

c) How many cakes have you bought in the last two weeks? ____ _____

d) How many cakes have you baked in the last two weeks? _____ _____

What kind? _____ _____

33. Would you tell me the various reasons you have for using eggs? _____

_____

34. Where have you heard or read of the health value of eggs? ____ _____

_____

The next few questions are slightly different from those previously asked. I have a chart with pictures of eggs right after they have been broken out of the shell. Try to forget the code numbers alongside the pictures since they are only of importance in identifying the eggs. All eggs on the chart are of the same weight--that is, the same size. Hold the chart any way you want--it doesn't make any difference. Disregard the yolk colors since the colors may be different due to methods of reproducing the photograph.

35. How would you rank the eggs on that chart from the best to the poorest?

b) What is there about egg x___ (ENUMERATOR! SELECT THE "BEST" EGG.) that you like more than the other eggs?

_____

c) What is there about egg x___ (ENUMERATOR! SELECT THE "POOREST" EGG.) that you like less than the other eggs? _____

d) Which egg on the chart looks most like the eggs you last used? _____

e) How much did you pay for that dozen? _____

f) If you had the choice of buying any of the eggs on that chart for poaching or frying, how much would you pay for a dozen if you knew they would all look like . . . (ENUMERATOR! REMIND THE RESPONDENT OF THE PRICE LAST PAID--in 35e)

x321	x922	x228	x462

g) If you had the choice of buying any of the eggs on that chart for baking, scrambling, and the like, how much would you pay for a dozen if you knew they would all look like . . . (ENUMERATOR!) REMIND THE RESPONDENT OF THE PRICE LAST PAID--in 35e)

x321	x922	x228	x462

36. Are there any yolk colors that you prefer for poaching

or frying? _____ _____

b) for custards _____ _____

c) for baking _____ _____

That's the end of the questions on eggs. There are just a few more questions I'd like to ask. They are a bit more personal but very important. The questions that you've answered will be worth much more with answers to the next few. Everything you say will be confidential.

37. Would you please tell me the approximate weekly income of each of the members of your household?

(ENUMERATOR: REFER TO PAGE 2 WHERE THE OCCUPATIONS OF THE FAMILY ARE GIVEN--ASK FOR EVERY MEMBER.)

Only put down income: _____

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Amount received from boarders
a)
Boarder's income _____

11. _____
12. _____
13. _____
14. _____

_____

(ENUMERATOR: IF THE RESPONDENT REFUSES TO GIVE THE INCOMES, TRY THE ACCOMPANYING CARD SHOWING BRACKETS OF INCOME CLASSES AND HAVE THE RESPONDENT SELECT FROM THE CARD THE WEEKLY INCOME BRACKET. DO THIS ONLY IF ABOVE INFORMATION IS NOT GIVEN.)

(x) Income Bracket _____ _____

38. Last Week's Food Bill $ _____ _____

39. Race _____ _____

40. RW--E _____ G _____ F _____ P _____